LAND MANAGEMENT HANDBOOK

47

Silviculture Prescription Data Collection Field Handbook

Interpretive Guide for Data Collection, Site Stratification, and Sensitivity Evaluation for Silviculture Prescriptions

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Interpretive Guide for Data Collection, Site Stratification, and Sensitivity Evaluation for Silviculture Prescriptions

M. Curran, I. Davis, and B. Mitchell

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PREFACE

This guide is a technical support document intended to help forestry practitioners collect the information they need to prepare a silviculture treatment regime and silviculture prescription in accordance with Forest Practices Code legislation. It deals primarily with the collection and stratification of site-specific field data. It has been designed to promote consistent collection of field data on Field Forms FS 39A and FS 39B. This guide is not meant to be a substitute for education, training, or experience in the field.

The use of this guide is not a statutory requirement and many of the data described in it are not directly required by legislation. An individual practicing due diligence, however, will collect appropriate information to develop site-specific prescriptions and the accompanying forms have proven quite popular for this data collection.

ACKNOWLEDGEMENTS

Many people have been involved in the development of this handbook over the years. B. Mitchell (retired, formerly Regional Soil Scientist, Kamloops Forest Region), D. Lloyd, and F. Russell wrote the first 15-page guide in April 1988. In November 1989, M. Curran prepared an expanded draft as a proposed soil course handbook. It further evolved into the draft report by Curran and Mitchell "Site Mapping and Field Data Collection for Site Sensitivity for the Kamloops and Nelson Regions" (March 1990). This draft report included resource values and management concerns outlined in both the "Silviculture Branch PHSP Procedures for Completing Provincial Forms 711 A, B, and C" by P. Diggle, and the "Regional PHSP Standard Operating Procedures for the Kamloops Region" by R. Newman.

Working closely with Regional Silviculture specialists, M. Curran and R. Newman developed the trial PHSP forms. Specialists in the Regional Silviculture, Protection, Range, Recreation, and Landscape sections and district silviculturalists in the Nelson Region reviewed these forms and the Kamloops procedures. The PHSP Procedure Working Group in Kamloops Region (R. Newman, E. Ganderski, P. Lishman, R. Backer, J. Jang, D. Embury, D. Horne, C. Roadhouse, and J. Fukumoto) also reviewed the forms. The resulting 1991 and 1992 versions of the draft handbook were widely distributed with the "trial forms." M. Lyons (Graphiti Information Systems, Nelson) produced the draft field forms published by the Ministry of Forests Research Branch. The Drafting Section in Nelson produced the figures and L. Robinson and J. Quinlan in Kamloops typed the manuscripts. G. Utzig contributed some of the figures.

G. Robertson (Forms Management, Technical and Administration Services Branch) produced the field forms, with logistical support by the Forms Management Analyst, P. Megson.

Working up to the 1993 version, T. Braumandl, G. Hope, W. Klenner, D. Lloyd, B. Peschke, J. Sutherland, H.A. Luttmerding, and G. Utzig provided helpful review comments in specific areas. D. DeLong, C. DeLong, G. Davis, D. Crampton, K. Cunningham, M. Madill, G. Hope, D. Mullett, L. Bedford, B. Fraser, B. Pamplin, S. Willie, J. Hilton, P. Sanborn, B. Chapman, and R. Trowbridge reviewed the manuscript. N. Becker (The *Kootenay Weekly Express*, Nelson) provided desktop publishing services. However, with the Forest Practices Code under development, the decision was made to postpone the publishing of the document as a Land Management Handbook, and to distribute in mimeograph form.

With the introduction of the *Forest Practices Code of British Columbia Act* and Regulations, the field cards and corresponding handbook required revision. C. Fietkau (McClarnon) (Silviculture Practices Forester, Victoria) took on the task of co-ordinating this new effort. In January 1996, Fietkau solicited input to make changes to the FS 711A, A-1, B-1, and D forms. Recommended changes came from D. Fraser, S. Willis, and B. Pamplin. In the interim, A. Waters and M. Curran updated the FS 711B form for the pending field season.

In May 1996, Ecosystems Management Ltd. (Merritt) was engaged to help codify the existing FS 711A, FS 711A-1, and FS 711B forms. I. Davis (proprietor) created new field forms with input from M. Curran and C. Fietkau. Reviewers of the newly proposed silviculture prescription field forms included C. Fietkau, M. Curran, T. Johnston, S. McRuer, S. Chatwin, D. Hudson, B. Pamplin, J. McClarnon, M. Scott, L. Anderson, F. Nicholas, G. Buhr, C. Gibson, I. Howes, J. Henigman, P. Byrne, K. Long, M. Osberg, P. LeBouder, G. Lachance, K. Conway-Brown, J. Harkema, and H. Merler. K. Ward (Desert Gardens, Merritt) drafted the revised field forms and G. Robertson (Forms Management, Victoria) produced the new FS 39A and FS 39B cards. K. Conway-Brown (Merritt), S. Willis (Prince Rupert), and H. Merler (Kamloops) helped with later revisions to the field forms.

These newly produced cards necessitated an update of the previously completed, but unpublished, Land Management Handbook. I. Davis (Ecosystems Management Ltd.) incorporated the required changes into the handbook. M. Curran, A. Waters, and C. Fietkau provided substantial help and input throughout this revision.

Forest Sciences and Silviculture staff in the forest regions reviewed the technical contents of the reworked handbook. C. Thompson (Nelson), E. Johanson (Cariboo), M. Fidgeon (Vancouver), S. Willis (Prince Rupert),

C. DeLong (Prince George), B. Pamplin (Kamloops), and G. Beaudry (Nelson) supplied useful revisions. A. Waters, P. Bradford, I. Miller, S. Gagne, and C. Fietkau (all of Victoria) and L. Marsh (Merritt) contributed additional comments. M. Curran provided invaluable assistance at this stage of the review process. J. Sam (Merritt) contributed useful information on aboriginal-related subject matter for the Interior of British Columbia.

D. Caruso (Flying Fingers, Tulameen) produced the new manuscript (including tables) with assistance from K. Ward, who reproduced some of the original manuscript figures and keys. S. Bannerman (Kaatza Publishing Services, Lake Cowichan) provided English editing services.

P. Nystedt co-ordinated the finalization of graphics. P. Nystedt and C. Fietkau co-ordinated the final compilation.

With further regulation changes pending, it was decided once again to distribute the handbook in mimeograph form, this time as "Silviculture Prescription Field Methods Book: Interpretive Guide for Data Collection, Stratification, and Sensitivity Evaluation for Silviculture Prescriptions" (Order No. SIL 411). This would allow for valuable feedback through field testing before final publication.

Following the regulatory changes, N. Densmore and M. Scott contacted L. McCulloch (Forest Management Services Ltd.) to update the text. B. Bruce provided proposed changes in March 1999 based on interaction with N. Densmore, and M. Scott, and input from M. Curran. M. Curran, N. Densmore, and M. Scott reviewed these changes. M. Curran also updated the Soil Disturbance Manual sections, and G. Kockx and G. Hope reviewed these. Ecology and Earth Sciences staff (D. Meidenger, S. Chatwin, E. Hamilton, and P. Tchaplinski) under the direction of G. Still, reviewed the resulting draft. I. Davis again edited the handbook for content consistency. N. Boultbee and Elaine Perepolkin incorporated the final editorial comments under the direction of M. Curran, with considerable input from I. Davis.

The work of Forest Practices Branch staff (C. Fietkau, N. Densmore, G. Kockx, M. Scott, P. Bradford, I. Miller, and S. Gagne) and Nelson Forest Region staff (B. Fraser and J. Pollack) is gratefully acknowledged. Their contributions of funding, coordinating sources, and technical expertise were integral to the various versions of this field guide.

P. Nystedt co-ordinated the final production—the editing services were provided by S. Bannerman (Kaatza Publishing Services, Lake Cowichan), and the layout was undertaken by P. Harris (Word Works Typographic, Victoria). The endless support and encouragement of Paul Nystedt throughout the many trials and tribulations of this handbook is greatly acknowledged.

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1 INTRODUCTION

The *Forest Practices Code of British Columbia Act* requires the preparation of a silviculture prescription (SP) when:

- harvesting is proposed;
- silvicultural treatments are proposed for timber that has been damaged or destroyed by natural causes;
- silvicultural treatments are proposed for areas where timber was harvested, damaged, or destroyed before October 1, 1987 (backlog prescription); or
- unauthorized harvesting has occurred.

An SP is a legal document containing management objectives and strategies that must be consistent with higher-level plans. It outlines the conditions required to accommodate known forest resources. It also provides standards for soil disturbance and stocking. Recent legislation eliminated the requirement for details about how forest practices are conducted. However, the Silvicultural Practices Regulation now requires a prescribed regime of silvicultural treatments to achieve a free-growing stand within the period specified in the SP.

Essential information required in an SP includes:

- management objectives consistent with other plans;
- ecological information and site characteristics (including limitations);
- specific management strategies;
- soil conservation requirements;
- proposed silvicultural system(s); and
- stocking requirements.

Although the Forest Practices Code stipulates the content of the SP, the collection of field data is not a legislated requirement. However, as a matter of professional accountability and due diligence, data must be adequate to support any management decisions made in the SP. This handbook provides helpful suggestions regarding data collection methods, including stratification, soil sensitivity evaluation, and initial prescription development. It contains definitions, descriptions, examples, and keys to facilitate site description. Often, more than one key is provided to help increase surveyor confidence, accuracy, and precision. Also referenced are other guides to the interpretation of field data and prescription development.

Field practitioners are free to develop their own forms for data collection. The comprehensive forms included in this handbook facilitate the description of virtually any significant site feature. The use of these forms is not

required by legislation; however, they have proven quite popular, are cross-referenced to numbered items in this handbook, and provide one means to organize and record information. **Nothing in this guide supersedes Forest Practices Code requirements.**

This handbook includes several sections. Section 2 briefly outlines the procedures for photo stratification, sampling, and mapping. Section 3 describes data collection techniques for SP field forms FS 39A and FS 39B, samples of which appear in Appendix 2 and 3. Appendix 1 contains definitions of many of the terms used in the silviculture prescription and treatment regime processes.

This handbook will continue to evolve with advances in forest practices, and in data collection and assessment procedures. Please direct suggestions for improvement to the senior author: M. Curran, Nelson Forest Region, 518 Lake St., Nelson, BC V1L 4C6 (e-mail: mike.curran@gems5.gov.bc.ca).

2 OFFICE PREPARATION, STRATIFICATION, PLOT ESTABLISHMENT, AND MAPPING PROCEDURE

2.1 Office Preparation

Before conducting any fieldwork, the surveyor should review relevant data already available. Information sources include:

- higher-level plans,
- forest development plans,
- policy and standard operating procedures,
- non-designated local resource management plans,
- range use plans,
- forest practices code guidebooks,
- ecosystem field guides, and
- resource inventories or assessments (recreation, visual, terrain stability, soils, forest health, gully, stream, wetland, lake, traditional land use, watershed, archeological impact, etc.).

Obtain aerial photographs at a scale equal to or larger than the final SP map scale, and gather a combination of available maps (see Table 1).

In addition to the aerial photos and maps, the following identify some of the other sources of information available to the surveyor.

Readers are advised to reference the most current versions of the references by contacting the responsible agency. The following are some of the sources of information available to the surveyor. Any local data on climate, forest cover, vegetation, bedrock and surficial geology, soils, hydrology, and terrain stability should also be compiled. After gathering the information described

TABLE 1 *Types of maps that can provide information for silviculture prescription data collection**

Type of map	Commonly available map scale
Forest Cover	1:15 000–1:20 000
Forest Development Plan	1:15 000–1:50 000
Local Resource Use Plan	1:15 000–1:20 000
Stream Assessment	1:20 000–1:50 000
Terrain Stability	1:20 000–1:50 000
Total Resource Plan	1:50 000
Forest Health (Pest Susceptibility)	1:50 000
Visual Landscape Inventory and Analysis	1:50 000
Soil/Landform	1:50 000–1:125 000
Ownership Status	1:50 000–1:200 000
Biogeoclimatic	1:100 000–1:250 000
Range Tenure	1:100 000
Geology	1:125 000–1:200 000
Trapper/Outfitter	1:250 000
Ungulate Winter Range	1:250 000

* Many of these maps are available online through the B.C. Ministry of Forests or the Ministry of Environment, Lands and Parks. Try: www.env.gov.bc.ca\gdbc or www.landdata.gov.bc.ca

above, the surveyor should focus on the mapping, stratification, and the strategy for field data collection.

Forest health charts: Appendix 6 of the *Establishment to Free Growing Guidebook*[1] for the forest region contains forest health charts. Use these to determine which forest health factors might be important. Stand susceptibility maps and inventories of specific forest health factors may be available from either the Ministry of Forests district or regional offices.

First Nations, traditional use, and cultural heritage resources: Some districts have a liaison officer or aboriginal affairs person to help with assessments. Cultural heritage resources include archaeological resources and traditional use sites. Archaeological impact assessments or traditional use studies can provide relevant information. After conducting the inventories, the Minister and First Nations leaders will endorse an Information Sharing Agreement that outlines the approach to information access. Traditional land use mapping, if available, may identify areas such as sacred sites, place names, trail locations, burials, cabin sites, harvest locations, culturally modified trees, and registered traplines.

Consulting with the appropriate First Nations people, who traditionally use or occupy the area, should still occur even when a traditional use study exists. The SP must accommodate any cultural heritage resources identified.

1 For a list of all Forest Practice Code Guidebooks referred to in this Handbook, see Appendix 8.

When drafting an SP, consider any existing district procedures about the communication of these resources on operational plans. Some of this information may be confidential (i.e., through the Aboriginal Rights and Title).

The following references may provide useful background information on these topics.

- *Archeological Impact Assessment Guidelines* (1995; Ministry of Small Business, Tourism and Culture, Archeology Branch)
- *Heritage Conservation Act*
- Aboriginal Rights and Title (1999; Aboriginal Affairs Branch)
- Ministry of Forests Consultation Guidelines (1999)
- Protocol Agreement on the Management of Cultural Heritage Resources (1996; Ministry of Small Business, Tourism and Culture and Ministry of Forests)
- *Traditional Use Study Program Guidelines* (December 1996; Aboriginal Affairs Branch)
- Culturally Modified Tree Management Procedures (1997; Ministry of Forests)

Note: The Heritage Conservation Statutes Amendment Act *(374/94) contains provisions allowing the Minister to refuse the disclosure of archaeological information in certain cases. This includes anthropological information of traditional, social, spiritual, or other cultural importance to a living community, which was obtained under conditions of confidentiality, or is confidential at the request of representatives of the community whose heritage is represented by the information.*

Wildlife information: The district's Ministry of Environment, Lands and Parks forest ecosystems specialist or habitat biologist can provide useful wildlife information. Also, consult Canada Land Inventory maps of Ungulate Capability. Conservation officers can often provide local knowledge about such features as mineral licks, game trails, raptor nest trees, bear dens, and caves. The *Identified Wildlife Management Strategy* (B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1999) contains other reference material.

To obtain information about the red- and blue-listed species in the forest district, contact the Conservation Data Centre (CDC) of the Ministry of Environment, Lands and Parks. The CDC can provide a list of rare and endangered vascular plants, vertebrate animals, and plant communities (available on the Internet at http://www.elp.gov.bc.ca/rib/wis/cdc). Plant communities have been correlated to biogeoclimatic ecosystem classification (BEC) site series. In some cases, the CDC can also provide map locations for these species. In future, the CDC will include invertebrates and non-vascular plants in their data bank.

Fish and fish-habitat inventories: Fisheries agencies may already have conducted inventories. If so, the district's forest ecosystems specialist should have maps outlining important water bodies. This information will help in determining the riparian classes for water bodies in the SP area. Determine whether the water bodies flow directly into, or are tributary to, fish-bearing waters. Consult with the appropriate agencies for further advice.

Recreation inventories: Available at most Ministry of Forests district offices, these inventories can provide information on the Recreation Opportunity Spectrum, recreation features, visual landscape sensitivity, and heritage trails and rivers. When consulting the visual landscape inventories, the surveyor must determine whether the subject area is in an identified or known scenic area or has established Visual Quality Objectives (VQOs). If the area has no established VQOs, a visual impact assessment will be necessary. Maps outlining VQOs are available for some important valleys.

Crown range: If Crown range use occurs near the proposed cutblock, consult Ministry of Forests range staff. Review range tenures, range plans, and local resource use plans, referring to their objectives for range use. Determine the identity of the range tenure holder, the number of grazing livestock, the season of range use, and any anticipated increases in forage production. Contact the tenure holder before the field assessment to determine whether any verbal agreements or unwritten plans will affect the silviculture prescription. The tenure holder can usually provide detailed local site knowledge. This may indicate that the proposed cutblock will breach a natural livestock barrier or an historical trail used by the tenure holder's herd or flock.

2.2 Stratification and Procedures for Plot Establishment

Silviculture Prescription stratification begins by delineating, on aerial photos, segments of the landscape where changes in topography and vegetative cover occur. This procedure is known as "pre-field stratification," or "pre-stratification."

Pre-stratification is later field-checked and refined to produce a final stratification and a map. The process of stratification and mapping encompasses five basic steps:

1. delineate areas with uniform topography and vegetation viewing aerial photos in stereo;
2. select potential plot locations and a field inspection route;
3. field-truth and assess pre-typed map strata and recorded physical features;
4. refine strata and delineate proposed interpretive units (including Standards Unit) and reserves; and

5. produce the final map(s), which should include symbols for map units and relevant physical features.

This handbook focuses on the first three steps and briefly discusses the last two steps.

2.2.1 Aerial photo stratification

Aerial photo stratification delineates tentative map strata and identifies physical features relevent to the SP. Verify, or establish, the scale of the aerial photo by measuring a feature on the photo and comparing it to a map with a known scale. Orient the photo, and on it mark the north arrow.

The following procedure for pre-stratification is suggested.

Step 1. Cutblock boundary delineation: Before undertaking pre-stratification, transfer the proposed cutblock boundary from a map to the most recent aerial photos (preferably 1:20 000 scale or larger). Ensure that any scale differences between the photo and the source map are reflected when establishing the boundaries. Use grease pencils or other non-permanent markers.

Step 2. Overview: Review the aerial photo pair under a stereoscope to get an overview of the proposed cutblock and the adjacent area. This overview may show that the proposed cutblock area is improperly located in relation to roads, topography, creeks, natural barriers, timber, and other nearby cutblocks. Bring location problems to your supervisor's attention and decide whether to make adjustments now or after field investigation.

Step 3. Physical features identification: Consider all "base map" information. On the photos, note any physical features (or conditions within or immediately adjacent to the block) that may affect, or be affected by, the SP. Physical features to note include:

- artificial structures or improvements (e.g., roads, utility rights-of-way, trails, water intakes, dwellings, fences);
- watercourses and any drainage channels leading to them; and
- gullies and natural barriers.

> ***Note:*** *Gully systems >5m deep should be typed out and assessed separately for soil disturbance hazard assessment during data collection in the Interior. On the Coast, gullies are subject to a separate gully assessment procedure.*

Because their location may be required for the final map, **note** these features for field inspection. Also, note any administrative considerations, such as lot boundaries and map notations.

Step 4. Environmental strata delineation: Identify uniform areas of topography and vegetation on the air photos. When considering topography, take into account slopes, aspects, and landforms. When considering vegetation, look at species composition, height of vegetation, and crown closure. A change in any one of these features may indicate a difference in site classification, quality, or some other interpretive feature. Delineate on the photos any visible environmental strata by considering physiography, BEC site series, and forest cover. A description of each follows.

- **Physiography** – Delineate any changes in landform, aspect, slope, and drainage pattern. When available, use soil and landform maps to understand local trends and recognize potential map strata (**note** where field-checking is required). Consider the following when delineating physiography:
  - ***Landform***: Changes in landform, such as terraces, fans, floodplains, drumlins, eskers, and knob and kettle topography.
  - ***Aspect***: Changes in aspect on slopes greater than 20% are generalized as colder (e.g., N, NE, E) or warmer (e.g., S, SW, W). This can be an important factor for crop re-establishment.
  - ***Slope***: Changes in slope that will affect choice of equipment for harvesting and site preparation (refer to available guides for harvesting and site preparation, and local experience). Generally, gentle slopes range from 0 to 20%, moderate slopes from 20 to 35%, and steeper slopes are greater than 35%.
  - ***Drainage pattern***: Changes in drainage pattern such as numbers or orientation of watercourses or gullies.

- **Biogeoclimatic Site Series** – Using the regional Biogeoclimatic Ecosystem Classification (BEC) guide, delineate any observable changes in site series within the distinct physiographic units just identified. The presence of certain vegetation types may help to delineate tentative site series. The objective is to outline potential changes in site series because these often result in different treatment regimes. To do this, you should:
  - establish an approximate subzone and/or variant for the cutblock using biogeoclimatic map(s) at the largest scale available;
  - interpret how slope within the physiographic units may affect potential site series (use mesoslope diagrams and environmental tables in regional ecosystem field guides; site series generally occur on slope segments of the landscape or landforms [Figure 1]); and,
  - pre-type tentative changes in site series within the physiographic units on the aerial photo using changes in slope, aspect, and vegetation.

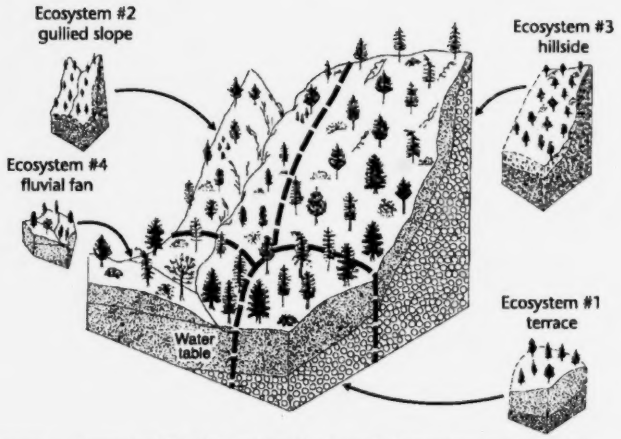


FIGURE 1 *Example of the delineation of site units (ecosystem or site series) on different segments of a landscape (modified from FRDA soil training course material).*

Refer to Mitchell et al. (1989) for further assistance in delineating site series map units. However, verify all site series by a field inspection.

- **Forest cover** – Delineate any further significant changes in forest cover that will form a separate stratum based on the management objectives for the cutblock (e.g., deciduous or immature; density or species of trees). Overstorey vegetation in climax stands is very helpful, but successional stands are more difficult because patterns may reflect disturbance history (e.g., lodgepole pine often reflects a fire).

  If a timber cruise map is available for the area (i.e., a timber cruise undertaken for a forest development plan or to prepare for a cutting permit), it may contain information about refined timber types and slope.

- **Other** – Delineate any other observable and significant changes in environmental conditions that may result in a different prescription (e.g., changes in the degree of pest infestation or changes in the amount of wildlife trees or slash potential).

The resulting preliminary environmental map strata may be simple or compound (Figure 2), because of complex topography or because the detail is too much for the insufficient map scale. Simple strata are relatively homogeneous and consist of primarily one site series. They have a maximum of

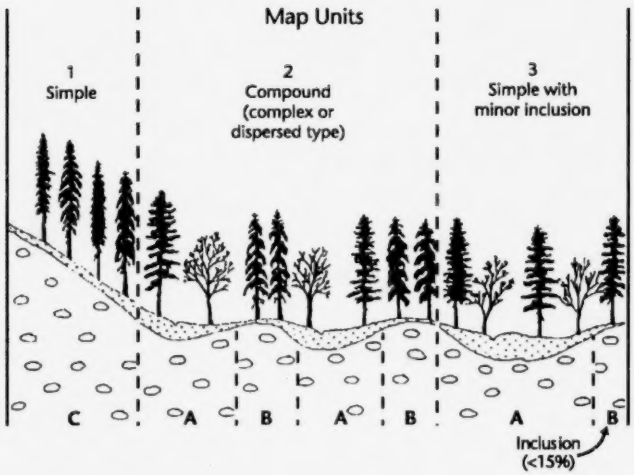


FIGURE 2 *Simple and compound map units (strata). The numerals 1, 2, and 3 represent map units; A, B, and C represent site series. Map unit 2 has an inclusion of > 15% site series B (adapted from Mitchell et al. 1989).*

15% inclusions (unmappable areas) of other site series or landscape features (e.g., rock outcrop, small wet areas). Compound strata (also known as "complex" or "dispersed type") consist of two or more intermingled site series, resulting in greater than 15% inclusions of the other site series.

Step 5. Interpretive unit delineation: Interpretive units are map strata based on management objectives and site attributes. These units are delineated after field data collection is complete and generally emphasize management values or concerns (e.g., wildlife, range, watershed, fisheries, etc.). They may amalgamate or subdivide environmental strata, and reflect ground observations, delineate artificial boundaries (e.g., a 200-m reserve from a known feature), or serve an administrative function. The most common form of interpretive unit used in the SP process is the "Standards Unit." A Standards Unit is an area managed through the uniform application of silvicultural systems, stocking standards, and soil conservation standards (see Section 2.3.1, "Proposed Standards Units").

Delineate any interpretive units that are known or visible at the time of photo stratification (e.g., a riparian management zone for a classified stream, an area with a specific visual quality objective).

The preliminary map strata boundaries delineated by following this five-step procedure can now be confirmed, or modified by a field assessment that will help define the final Standards Units for the SP.

2.2.2 Field inspection route

On the pre-stratified photos, identify a convenient starting point (Point of Commencement [POC]) for the field inspection. This point should be tied to a permanent physical feature, such as a road junction, swamp, rock outcrop, or creek. From this point, delineate a route for the field assessment that will transect all tentative strata and visit each physical feature (Figure 3). This route should traverse most of the block to assess potential strata not obvious through aerial photo interpretation. It should also facilitate observations of stand, site series, landform, and soil conditions. If the area has been timber-cruised recently, obtain the final cruise map to help plan a route. Use cruise strips to maintain your orientation and to focus attention on soil, ecological, and other factors. Recognize that simply following cruise strips may miss important features.

Conduct the field assessment during the snow-free period, on unfrozen soil, when management factors of concern are most apparent (i.e., those of concern for that block or cutting permit, such as competing vegetation, wildlife, seepage, etc.).

While navigating along the transect, sample the strata delineated on the air photos (see Section 2.2.3, "Plot Sampling Procedures"), and modify as

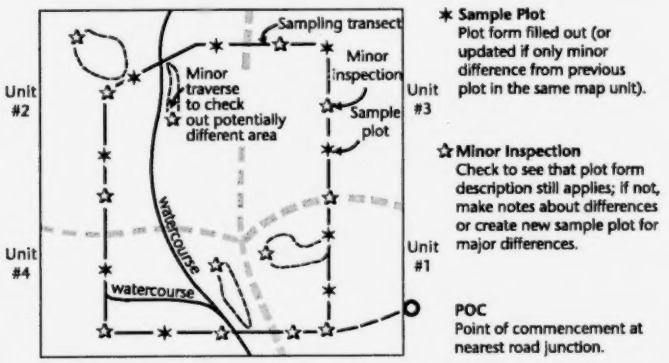

Sampling transect
Minor inspection
Minor traverse to check out potentially different area
Sample plot
Unit #2
Unit #3
Unit #4
Unit #1
watercourse
watercourse
Sample Plot
Plot form filled out (or updated if only minor difference from previous plot in the same map unit).
Minor Inspection
Check to see that plot form description still applies; if not, make notes about differences or create new sample plot for major differences.
POC
Point of commencement at nearest road junction.

FIGURE 3 *Example of a transect for plot sampling a cutblock (units 1, 2, 3, and 4 relate to the landscape cross-section in Figure 1).*

necessary. Transects running up and down the slope facilitate the identification of boundaries associated with changes in moisture regime. While navigating between plots along the transect, record information pertaining to changes in site series, brush levels, timber volume and species composition, soil texture, pest evidence, non-timber resource values, etc. Note on the map or photo the location where the information was collected and amend the pre-stratified stratum boundary, along the way, based on inter-plot and plot notes. Major changes usually result in new strata and the need for another detailed plot.

2.2.3 Plot sampling procedures

The collection of detailed ecological and resource information occurs concurrently with field stratification and mapping. Detailed sample plots are useful, and often necessary, to adequately characterize the strata. Adjust stratification and mapping as plot information is collected. Although the collected plot information assists in developing a prescription, the prescription may not be prepared until weeks, or even months, after the data are gathered. For this reason, it is important to document enough information to prepare a technically sound and defensible prescription, particularly when critical site factors such as terrain stability and soil sensitivity are involved.

Establish at least one detailed plot for each map stratum. However, if the management objectives or ecology is complex, or the surveyor lacks local site knowledge, the number of plots should be increased. For large strata, establish one detailed plot for every 10 ha. Within a compound map stratum, establish a detailed plot within each included site condition needing characterization.

To establish a plot, select a sample site that appears most representative based on photo interpretation. Make numerous "soil check pits" and other observations during the walk-through. Soil can be checked between detailed plots with a stony soil auger; however, a full pit is needed at the detailed plots. Avoid establishing plots in transitional areas. In uniform strata, conduct at least two check pits or auger observations for each established sample site (detailed plot); in variable strata, up to 10 or more maybe required.

For each established plot, dig a soil pit to a depth adequate to conduct a soil disturbance hazard assessment. Minimum depth will vary, depending on the site. The compaction hazard is based on the top 30 cm of soil, but a 60 cm or deeper pit is often required to determine any of the other soil disturbance hazard ratings (e.g., depth to unfavourable substrate for soil displacement).

At each established detailed plot, complete a Silviculture Prescription Plot Card (FS 39A), or equivalent, according to the procedures outlined in

Section 3.2.1. Provide as much detail as is required to support the prescription. Before leaving the plot, locate each sample plot on the SP map and label the site series number (e.g., 04; as determined from the regional ecosystem field guide) on the aerial photo or field map.

2.3 Mapping Procedures

Mapping provides a spatial representation of the data collected in the field.

2.3.1 Proposed Standards Units

While still in the field, decide on final interpretive units; use collected plot information to confirm or modify the strata that were proposed during aerial photo stratification (Figure 4). Assign interpretive (Standards) units based on common, specific objectives for that section of the landscape (see Step 5, Section 2.2.1, "Aerial Photo Stratification"). No matter what type of interpretive unit is designated, the stratification process must ensure that the SP will protect the soil resource and the environment during any harvesting, regeneration, and stand-tending treatments conducted in the area.

Ideally a single BEC site series will form the basic unit of stratification. However, strata in the field are rarely environmentally uniform. Strata are often compound (i.e., >15% other site series included). A compound stratum can complicate the writing of an appropriate prescription, especially when the included site series cannot easily be mapped.

When formulating Standards Units, consider the following suggestions.

- Combine dissimilar site series into one Standards Unit only where it is possible to apply the same silvicultural system, stocking standards, and soil conservation standards without compromising site integrity.
- If only the soil conservation standards change (under uniform application of silvicultural system and stocking standards), dissimilar site series may be combined into one Standards Unit if the Standards Unit will be managed for the most constraining soil factor for the combined strata. The surveyor may combine areas of dissimilar soil disturbance hazard ratings within one Standards Unit as long as the most sensitive of the soil disturbance hazard ratings along with the lowest recommended soil disturbance limit is specified.
- When it is not possible to manage to the same silvicultural system, stocking standards, and soil conservation standards in all site series within a complex stratum, different Standards Units may have to be applied to each site series. If they cannot be mapped, the unmappable Standards Unit(s) should be described in textual detail, in the SP and on the SP map. Include any specific prescriptions that are applicable for each unmappable Standards Unit(s). The management of unmappable

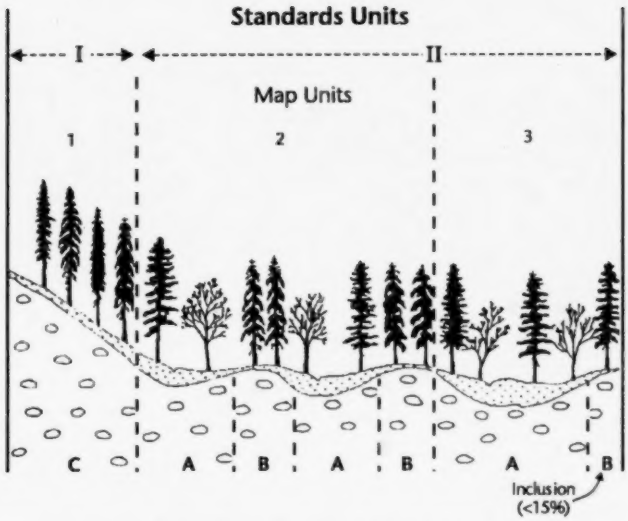


FIGURE 4 *Map units (see Figure 2) stratified into two Standards Units (I and II). The numerals 1, 2, and 3 represent map units; A, B, and C represent site series (adapted from Mitchell et al. 1989).*

Standards Units will require good supervision during prescription implementation. If the site series inclusions can be accurately mapped and described, this would be helpful.

- Other complications with stratification can occur when specific management practices or constraints need to be incorporated into the prescription. Areas with management constraints could include lakeshore management areas, riparian management areas, areas with visual quality objectives, wildlife habitat areas, or areas containing multiple non-contiguous small openings (i.e., salvage operations, group selection patches, group shelterwood strips, etc.).
- Do not create more Standards Units than are necessary.

Example: Three patches within a very rich ecosystem are scheduled for harvesting over a period of 4 years. Although the area under all three patches is ecologically uniform, time is critical in regenerating the patches, since competing vegetation can affect the new stands. For this reason, each patch is a separate Standards Unit, with its own regeneration and free-growing dates.

Example: Within a 12 hectare SU, a 2 hectare patch has a sensitivity to soil disturbance rating of "very high" while the remaining 10 hectares are rated "moderate". Unless this 2 hectare area is mapped and described as a separate SU, the entire 12 hectares must be managed for the "very high" sensitivity rating.

> ***Note**: Before leaving the site, delineate proposed Standards Units on the aerial photos, and develop an initial map by outlining proposed SU's and reserves (see Section 2.3.2), along with any other relevant features. Also develop an intial prescription by briefly summarizing the preferred treatment for each proposed SU.*

2.3.2 Proposed reserves

Based on the field assessment, delineate any proposed or required reserves. Reserves take on numerous forms: single trees (e.g., green trees or wildlife trees assessed as safe), forested patches (for wildlife, unstable ground, scenic, or hydrology purposes, etc.), or areas surrounding an important feature (lakes, streams, wetlands, etc.). Reserves are maintained for one rotation or longer.

Reserves are not usually harvested. However, to address a management objective such as forest health, harvest entries may be required. **When harvesting is considered necessary within a reserve, assign a Standards Unit** that includes measures to address the specific management objectives. Where retention of trees is required for very short periods, such as for seed or shelterwood trees, then do not record these trees as reserves.

Map reserve patches of 0.25 ha accurately on 1:5000 or 1:10 000 site maps (1 ha on 1:20 000 maps). Record patches of less than 0.25 ha, or scattered individuals, with a symbol on the map. Alternatively, indicate the minimum number of reserve trees per hectare on the map. For a further discussion on reserves, refer to Section 3.2.2 (ITEM 17).

2.3.3 Final map preparation

The final SP map is interpretive, relating specific management practices to the chosen strata. Prescription and map clarity are crucial to the success of the SP, as numerous people must decipher the treatments and standards outlined in the SP for at least a decade. As required by the *Operational Planning Regulation*, silviculture prescription maps must include administrative information, known resource values, and ecological information, as well as Standards Units and area summaries. In some cases, two or more maps will be required. Display the relevant BEC site series, sensitive areas, and other critical site factors on one map (or more, depending on the complexity involved). On subsequent maps (if required for clarity), display the Standards Units, other interpretive units, reserves, and proposed features (e.g.,

roads). Refer to regional and district procedures for specific requirements (e.g., scale and format).

Base map: Provide a base map at a scale acceptable to your region or district showing all the physical features and administrative details for the cutblock, as well as for a minimum distance surrounding the external boundary of the cutblock. Physical features, such as artificial structures or improvements (e.g., roads, utility rights-of-way, trails, water intakes, dwellings, or fences), streams, wetlands, lakes, gullies, or natural barriers, should be shown on the final map. Use accepted drafting techniques and ensure that the base map is consistent with the Ministry of Forests *Visual Identifier Standards Guide*.

Use Ministry of Forests forest cover maps as the starting point for field map development. These may also be suitable as the final base map. (A contour map is recommended in areas of complex topography.)

Forest cover: If it will enhance the base map, show existing forest cover within the proposed or existing cutblock, and the area adjacent to the external boundary of the cutblock. Many surveyors do not show forest cover at all, as it can result in a cluttered map. Others prefer to show topographical contour lines. Interpret, map, and label forest cover from the aerial photos or forest cover maps, using field-verified corrections, as necessary. On the final SP map, indicate any changes in forest cover from the base map.

Cutblock and interpretive units: On the final SP map(s), show and label the external boundary of the cutblock, site series, and Standards Units within the cutblock, as well as any reserves greater than 0.25 ha (wildlife patches, riparian, lakeshore, etc.).

Show labels for site series as either simple (e.g., 02) or compound (e.g., $01_{6}02_{4}$). In the case of a compound stratum, the subscript represents the proportion of the unit occupied by that site series to the nearest 10%. For instance, in the above example, 01 occupies 60% of the unit and 02 occupies 40% of the unit.

Biogeoclimatic ecosystem classification mapping should try to outline dominant site series, with minor site series shown only where they affect management requirements, as incorporated in Standards Units. Delineate very small units only when they significantly affect the prescription.

Other: Identify any of the following resources within, or adjacent to, the cutblock: existing range improvements (e.g., fences, cattle trails, cattle guards, corrals, salt licks, grass seeding), recreation or landscape features (e.g., recreation sites, trails), and other existing disturbances.

In addition, show any features or strata that will be proposed in the prescription. This would include roads, landings, gravel pits, and machine-free zones. The surveyor may feel that adding machine-free zones will contribute to map clutter. If this is the case, place a written comment in the map legend (and in the final prescription) to indicate that all streams, wetlands, and lakes will contain machine-free zones of a specified size.

Map format: Various styles of layout and format for SP maps are acceptable. Although not mandatory, the following information may simplify administration and provide useful references to the prescription document:

- a map heading that includes tenure, location, and opening number;
- graphics that show the various features and strata;
- a legend that includes explanations of strata, symbols, BEC units, and activities;
- an area summary that includes the number of hectares in the Standards Units, non-productive natural and unnatural or non-commercial cover of more than 4 ha in area, and reserves; and
- an administrative section that includes date, draftsperson, and scale.

Use different and distinguishable line styles for forest cover, cutblock boundary, interpretive units, and other map strata. The *Visual Identifier Standards Guide* provides line styles that can be used, but variations are allowed if using different CAD (computer-assisted drafting) or other drafting systems.

Label and describe each map stratum within the cutblock. To avoid clutter on the map, separate maps or larger-scale maps may be necessary.

> ***Note**: In the course of managing a cutblock, the SP map(s) will be photocopied and referred to many times. Therefore, carefully consider the limitations of any colour enhancement techniques used in mapping. Cross-hatching symbol and line weight techniques can facilitate the reproduction of critical details.*

3 DATA COLLECTION PROCEDURES FOR SILVICULTURE PRESCRIPTION FIELD FORMS

3.1 Field Data Forms

Two forms have been designed to collect silviculture prescription field data. However, the use of, and submission of, these forms is not a mandatory requirement under the Forest Practices Code. Appendices 2 and 3 contain examples of these forms. The Silviculture Prescription Plot Card (FS 39A) is used to capture plot-specific data. The Silviculture Prescription Stratum

Card (FS 39B) is used to summarize field data for a specific stratum (i.e., Standards Unit). Both enable the collection of readily observed field data. Information obtained from the office review or from interviews with affected parties is not included on these field forms. These cards can be used to collect data for proposed cutblocks as well as for existing openings, including openings that were created by means other than harvesting, for which silviculture treatments will be scheduled.

Along the left-hand side, each field form is divided into data collection sections (SITE, UNDERSTOREY, OVERSTOREY, SOILS, etc.). Within each section, a separate number and short heading (10. ASPECT, 15. SLOPE POSITION, etc.) identify data collection needs; these are cross referenced to numbered items in this handbook. For each of these numbered items, this handbook provides a description of the data field. In many cases, it provides further explanation or information about management considerations. Some of these topics are covered more thoroughly in Forest Practices Code guidebooks or regional ecosystem field guides.

Before collecting any data, surveyors should become familiar with the legal prescription requirements for any given site. Gathering non-relevant field data is almost as costly as repeated trips to gather additional data. Balance this with the fact that returning to a site to collect forgotten data, or planning a prescription without adequate site data, can be very costly as well.

3.1.1 Silviculture Prescription Plot Card (FS 39A)

Use this form at the assessment plot to collect site, understorey, overstorey, soils, and soil disturbance hazard data. Assess soil disturbance hazard data by examining a representative soil pit. Examine additional pits to confirm data consistency or to document soil variation. In addition, use this form to indicate any slope instability features and to record further comments or sketches.

3.1.2 Silviculture Prescription Stratum Card (FS 39B)

Use this form to create an initial field prescription for each stratum. Identify operational considerations related to riparian areas, reserves, fire and windthrow hazards, silviculture management objectives, harvesting, forest health, limiting factors, and other resource values and concerns. This information will help to define any operational constraints to the SP.

Complete as many sections of the stratum card as are necessary to demonstrate that all upper-level planning, other resource concerns, and limiting factors have been identified, verified, and addressed in the field. While field recommendations are helpful, they may be modified in the final SP.

3.2 Data Collection Procedures

The following section outlines specific data collection requirements for the two field cards. Definitions, descriptions, references, or keys are provided to simplify the data collection process. For a number of items, more than one key is supplied. This feature should enable the field surveyor to increase their confidence, accuracy, and precision when determining a particular property (e.g., soil texture).

3.2.1 Silviculture Prescription Plot Card (FS 39A)

REFERENCE DATA

1. LICENCE NO.
Record the tenure number (FL A01234, TFL 018, etc.).

2. LICENSEE
Record the person or company name of the tenure holder, **not** the contractor name. If Small Business Forest Enterprise Program, record as such.

3. CUTTING PERMIT (C.P.)
If applicable, and known, record the cutting permit number.

4. BLOCK
Record the cutblock number of the cutting permit for this SP. Use this data field to record the Ministry of Forests opening number for areas that were created by means other than harvesting.

5. STRATUM
Record the stratum (e.g., A, B, C) to which the field data (plot) are applicable. This will often be decided after all fieldwork is complete.

6. PLOT NO.
Record the plot number. Each plot must have a different number within the cutblock or opening.

7. SURVEYOR(S)
Record the name(s) (not initials) of the person(s) who collected and recorded the SP field data. Record the field assessment date.

8. LOCATION
Provide any local names for the area. This is useful when referring to the area in any correspondence.

SITE DATA

9. ELEVATION (m)
Provide the elevation of the plot in metres. Measure elevation with an altimeter, which is set daily to a known elevation benchmark.

10. ASPECT
Provide the direction that the plot is facing by letter code (e.g., E, N, S, W, NE, NW, SE, SW, V = variable). If there is no aspect, record as "flat." If aspect is variable, indicate the range (e.g., SW to SE). If all parties agree, use degrees azimuth. Set the compass to the correct declination for the area to compensate for local magnetic variations.

11. SLOPE (%)
Record the percent slope gradient extending up- and downslope of the plot, using a clinometer or Abney level. Slope gradient is the average inclination of the ground surface from the horizontal plane.

12. BGC ZONE, SUBZONE, VARIANT
Determine and record the biogeoclimatic zone, subzone, and variant for the plot. Record as codes, using those presented in the regional ecological field guide. For example:

BIOGEOCLIMATIC ZONE, SUBZONE, AND VARIANT

ZONE	SUBZONE	VARIANT
ESSF	dc	1
IDF	xh	2

Record transitions between subzones or variants, if they are present. Indicate the most appropriate zone/subzone/variant(s) when transitions exist (e.g., between the SBS and ESSF zones, the maximum free-growing delay for the SBS is 15 years, while in the ESSF the delay is 20 years). Similarly, some site series, subzones, and variants receive higher silviculture appraisal allowances than others. You must be able to defend your determination on the basis of observed ecological characteristics.

Phase: If applicable, record the recognized "phase" descriptor provided in the regional ecological field guide (e.g., IDF xh2a).

Site Series: Use the regional ecological field guide to determine and record the numeric site series (01, 02, etc.) for the area. This is usually done after

assessing the understorey vegetation. Site series are sometimes partitioned into phases according to critical site factors considered to affect response to management practices. Record any applicable site series phases beside the site series.

13. MOISTURE

From the keys in the regional ecological field guide or the keys shown in Figures 5 and 6, determine and record the soil moisture regime for the plot. Use word or number designations (e.g., mesic or 4). Some users prefer numeric codes for data entry and comparative purposes.

> ***Note:*** *Proper determination of soil moisture regime requires an assessment of selected physiographic features (e.g., slope position, slope gradient, aspect), soil features (e.g., soil depth, texture, coarse fragment content), and vegetative features (e.g., indicator plants). If two options are available for this determination, work through both to see which one makes more sense. Remember that natural slopes generally continue above and below haul roads.*

14. NUTRIENTS

From the keys in the regional ecological field guide or the keys shown in Figures 7 and 8, determine and record the soil nutrient regime for the plot. Use word or number designations (e.g., poor or B). Some users prefer letter codes for data entry and comparative purposes. Figure 9 illustrates some relationships between soil properties and soil nutrients.

> ***Note:*** *As with the soil moisture regime, selecting a soil nutrient regime requires the consideration of existing soil properties and vegetative features.*

15. SLOPE POSITION

Provide the slope position for the area surrounding the plot. Record the position as crest, upper slope, middle slope, lower slope, toe, depression, or level (see illustrations in Figure 10 and descriptions in the regional ecological field guides).

In the context of SPs, slope position is defined for an area greater than 0.5 ha, with a vertical difference of 3–300 m. This mesoslope position often falls within one of the macroslope positions (Figure 10).

Crest: The generally convex uppermost portion of a hill (mesoscale); it is usually convex in all directions; no specific aspect.

Upper slope: The generally convex upper portion of the slope of a hill (mesoscale) immediately below the crest; it has a convex surface profile with a specific aspect.

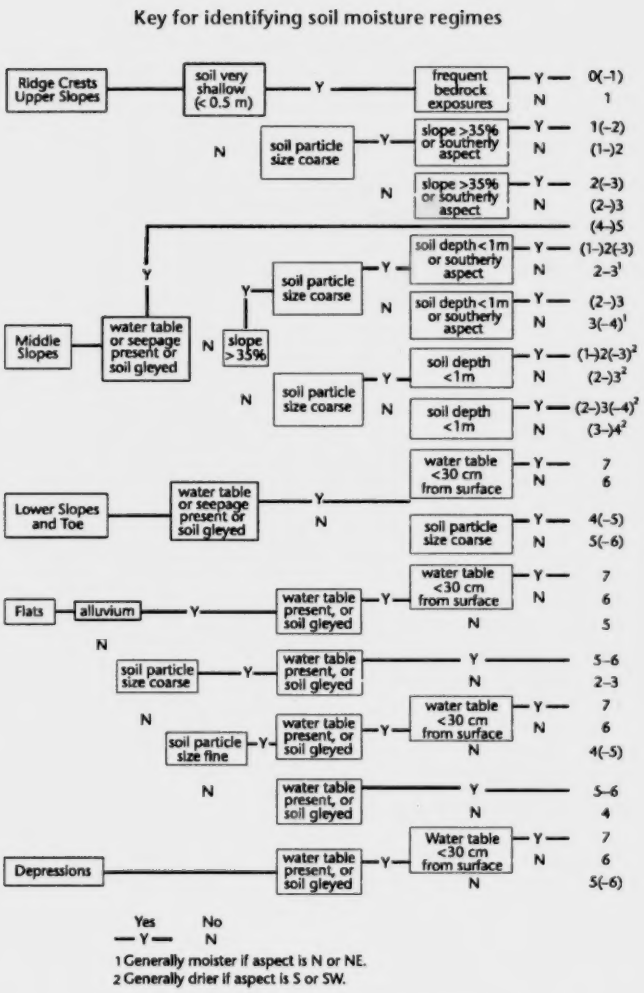


FIGURE 5 *Key for identifying soil moisture regimes (adapted from Green et al. 1984).*

FIGURE 6 *Key for evaluating site factors and determining soil moisture regime classes (Lloyd et al. 1990).*

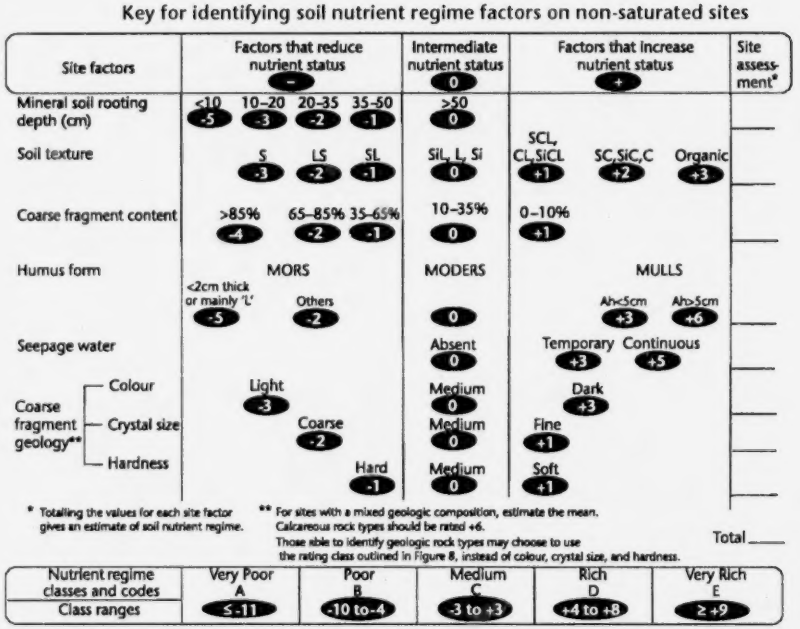


FIGURE 7 *Key for identifying soil nutrient regime factors on non-saturated sites (Lloyd et al. 1990).*

Key for identifying soil nutrient regime factors on saturated sites

Site factors	Factors that reduce nutrient status				Intermediate nutrient status	Factors that increase nutrient status			Site assessment*
	–				0	+			
Geologic source of seepage**	Granite Quartzite	Gneiss Granodiorite Rhyolite		Sandstone Quartz-Diorite	Conglomerate Breccia	Gabbro Schist Slate	Basalt Shale Mudstone	Ultramafics Limestone Marble	
	-6	-4		-1	0	+1	+2	+3	
Humus form	Histomor		Hydromor Histomoder		Hydromoder	Hydromull		Saprimull	
	-2		-1		0	+1		+2	
Nutrient regime classes and codes	Very poor A		Poor B		Medium C	Rich D		Very rich E	
Class ranges	≤ -5		-2 to -4		-3 to +1	+2 to +4		≥ +5	

* Totalling the values determined for each site factor gives an estimate of soil nutrient regime. Total ____

** A key to the identification of common rocks is presented in Figure 26.

FIGURE 8 *Key for identifying soil nutrient regime factors on saturated sites (Lloyd et al. 1990).*

Relationships between available soil nutrients and soil properties

Soil property (characteristics)	Soil nutrient regime				
	Very poor A	Poor B	Medium C	Rich D	Very rich E
Humus form	Mor			Moder	Mull
A soil horizon	podzolic Ae horizon present		A horizon absent	Ah horizon present	
Effective soil depth	shallow (≤30 cm)	moderately deep (>30 cm)			
Soil organic matter content (soil colour)	low (light-coloured soils)		medium (soils intermediate in colour)	high (dark-coloured soils)	
Soil texture	coarse (sandy)		medium to fine (loamy to clayey)		
Coarse fragment content	high(≥35% for sandy soils, ≥70% for loamy soils		low (<35% for sandy soils, <70% for loamy soils)		
Soil mineralogy	base–low		base–medium	base–high	

FIGURE 9 *Relationships between available soil nutrients and soil properties (adapted from Klinka et al. 1984; Lavender et al. 1990; and Banner et al. 1993).*

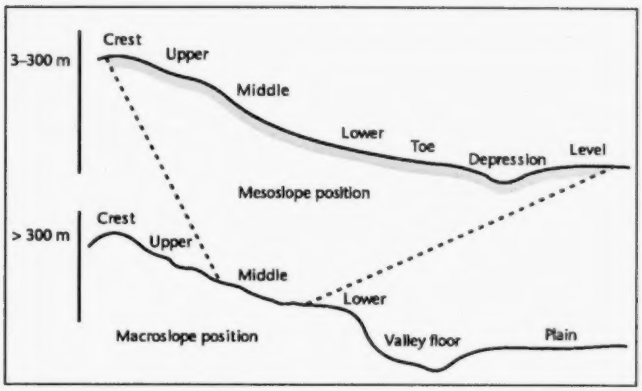


FIGURE 10 *The location of mesoslope position within a macroslope toposequence (from Lloyd et al. 1990).*

Middle slope: An area between the upper and lower slopes, where the surface profile is not generally concave or convex; it has a straight, or somewhat sigmoid, surface profile with a specific aspect.

Lower slope: The area toward the base of the slope; it generally has a concave surface profile with a specific aspect.

Toe: An area defined by an extent of uniform gentle slope below and adjacent to the lower slope; it has a specific aspect.

Depression: Any area that is concave in all directions; generally at the foot of a mesoscale hill or in a generally level area; no specific aspect.

Level: Any level, mesoscale area not adjacent to a mesoscale hill (i.e., not a toe); it has a generally straight (horizontal) surface profile with no significant aspect.

16. SURFACE SHAPE

Record the surface shape as convex, concave, or straight (see Figure 11). Measure the surface shape both up and down the slope. Indicate whether the ground surface is hummocky for each of the three surface shapes (e.g., convex, hummocky).

Hummocky: Very uneven ground surface (e.g., > 2 m relief across the contour).

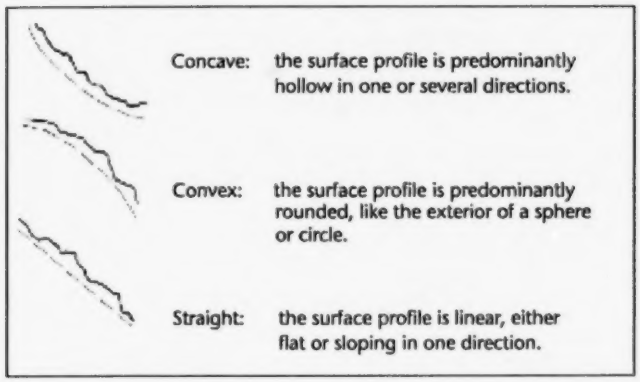

Concave: the surface profile is predominantly hollow in one or several directions.
Convex: the surface profile is predominantly rounded, like the exterior of a sphere or circle.
Straight: the surface profile is linear, either flat or sloping in one direction.

FIGURE 11 *Illustration of site surface shape (from Luttmerding et al. 1990).*

17. SLOPE LENGTH AND UNIFORMITY

Describe the slope length and uniformity. Length is recorded as short or long (see Figures 12 and 13). Uniformity is recorded as broken or uniform. Both are determined up and down the slope.

Short: Unimpeded slope length (< 150 m) between **level or adverse slopes**, which impede the continued flow of water; **or**
Long: Unimpeded slope length (≥ 150 m) between **level or adverse slopes**, which impede the continued flow of water.

Broken: Variable, complex, or broken slopes, with changes in slope that are > 30% and occur relatively abruptly; **or**
Uniform: Gradually changing slope.

> ***Note:*** *Natural slopes continue above and below haul roads unless they are built on level or adverse benches ≥ 20 m wide.*

18. SLOPE CONTINUITY

Indicate whether the slope is discontinuous (Figure 14) or continuous (Figure 15). Slope continuity influences the movement of seepage water and, if a landslide were to occur, influences slide behaviour.

Discontinuous: Slope length (< 150 m) between slope segments, **which are at least 20 m wide and less than 30% slope gradient**, or between ridge crests and valley bottoms; **or**

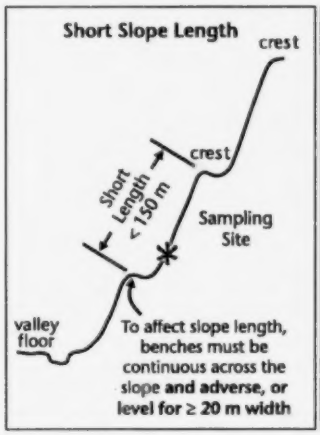

Short Slope Length
crest
crest
Short Length < 150 m
Sampling Site
valley floor
To affect slope length, benches must be continuous across the slope and adverse, or level for ≥ 20 m width

FIGURE 12 *Schematic illustration of short slope length.*

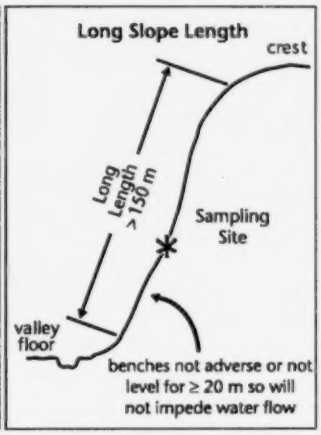

Long Slope Length
crest
Long Length > 150 m
Sampling Site
valley floor
benches not adverse or not level for ≥ 20 m so will not impede water flow

FIGURE 13 *Schematic illustration of long slope length.*

Continuous: Slope length (≥ 150 m) between slope segments, **which are at least 20 m wide and less than 30% slope gradient,** or between ridge crests and valley bottoms.

19. GULLIES / 100 m

Indicate the number of sharp-edged (V-shaped) gullies greater than 2 m deep per 100 m along the contour. This information relates to ratings derived for the Soil Displacement Hazard and, in the Interior, the Mass Wasting Hazard.

Gentler, rounder gullies are not a concern because extra excavation would not be involved in crossing such gullies.

UNDERSTOREY DATA

20. UNDERSTOREY (INDICATOR / ABUNDANT SPECIES)
(AREA 20 × 20 m, or __ × __ m)

Describe each understorey layer separately. Descriptions include layer percent cover, individual species percent cover, and the significant species by layer. Ideally, the plot is located in an area that is representative of the stratum, and the area described is 20 × 20 m surrounding the plot centre. However, the understorey plot need not be 20 × 20 m, but should cover an area of 400 m^2. Vary the dimensions of the plot (e.g., 10 × 40 m) to avoid any edge effect or bias (e.g., when plot falls within a narrow portion of a

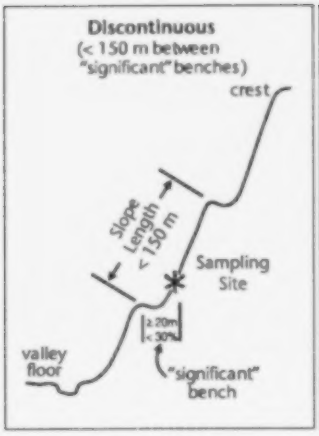


FIGURE 14 *Schematic illustration of a discontinuous slope.*

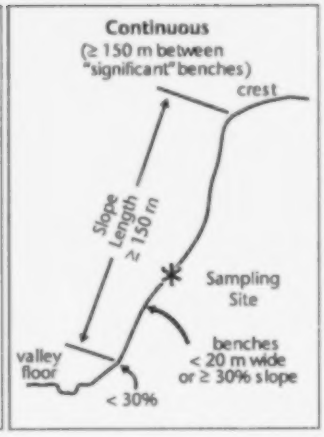


FIGURE 15 *Schematic illustration of a continuous slope.*

stratum). Whatever the dimensions, specify the size of the plot chosen for the description. If the site series is typical of the BEC, collecting detailed understorey information within the plot is not necessary. However, detailed description is particularly useful when areas:

- do not fit the description of the site series,
- fall within transitional areas between subzones and variants,
- contain seral vegetation, complexes of site series, or potential competing vegetation.

Understorey data are useful when making decisions about the site preparation treatment, wildlife forage, and restocking species selection for the site.

Layer: Three understorey layers are recognized: Shrubs, Herbs, and Bryophytes (i.e., mosses, lichens, and liverworts). Describe each layer separately and use the regional ecological field guide to determine which layer a species represents.

Layer Percent Cover: For each layer (shrub, herb, bryophyte) in the plot, record the percent cover. While the percent cover of each species in a layer can add up to over 100%, the layer percent cover can not exceed 100%. Layer percent cover is similar to crown closure and gives the percent of ground space occupied (from a vertical projection) by the crowns (foliage) of all species in that layer. If a layer is absent, record as NIL or zero percent cover.

***Note**: When estimating percent cover, take care not to bias estimates because of crown (foliage) density. Except for distinct holes in the foliage cover, the area within the perimeter of the crown of each species is assumed to be fully covered. Figure 16 is helpful in estimating vegetation percent cover.*

Species: Use this section to record significant species in a layer. Significant species may include, but are not limited to:

- ***Indicator species*** – Species typical of the site series (see regional ecological field guide)
- ***Abundant species*** – Species with over 25% cover, or the "most" abundant species
- ***Wildlife species*** – Species that have special importance for identified wildlife

Record species by their common name provided it is consistent with those in the regional ecological field guide. Alternatively, use the first four genus letters and first three species letters of the scientific name (e.g., Rhodalb = *Rhododendron albiflorum*).

Species Percent Cover: For each species recorded within a layer, provide its percent cover. The percent cover for an individual species may total to 100% (no crown overlap is recognized within one species) and the added percent cover of all individual species within a layer may exceed 100% (crown over lap between species is recognized).

21. COARSE WOODY DEBRIS

The prescription must state the volume and range of piece sizes of coarse woody debris (CWD) necessary or required to accommodate any objectives for CWD established in a forest development plan. Taylor (1997) provides useful information on a procedure for deriving these measurements.

Describe, for the 20 × 20 m plot (or the plot area chosen for ITEM 20), any coarse woody debris (sound and rotting logs and stumps usually > 7.5 cm in diameter) that existed before harvesting. Maintaining coarse woody debris after harvesting is a critical element of managing for biodiversity. In addition, coarse woody debris can limit the use of some site preparation equipment. Record the relative importance of coarse woody debris; more space is available under Comments (ITEM 45 or 47). Generally, the less large coarse woody debris on a site, the more important it is.

22. COMPETING VEGETATION / NOXIOUS WEEDS

Record any species that occur in, or adjacent to, the plot that will compete with future crop trees. For each competitor identified, record SPECIES, PRESENT HEIGHT (cm), EXPECTED HEIGHT (cm) after tree canopy removal.

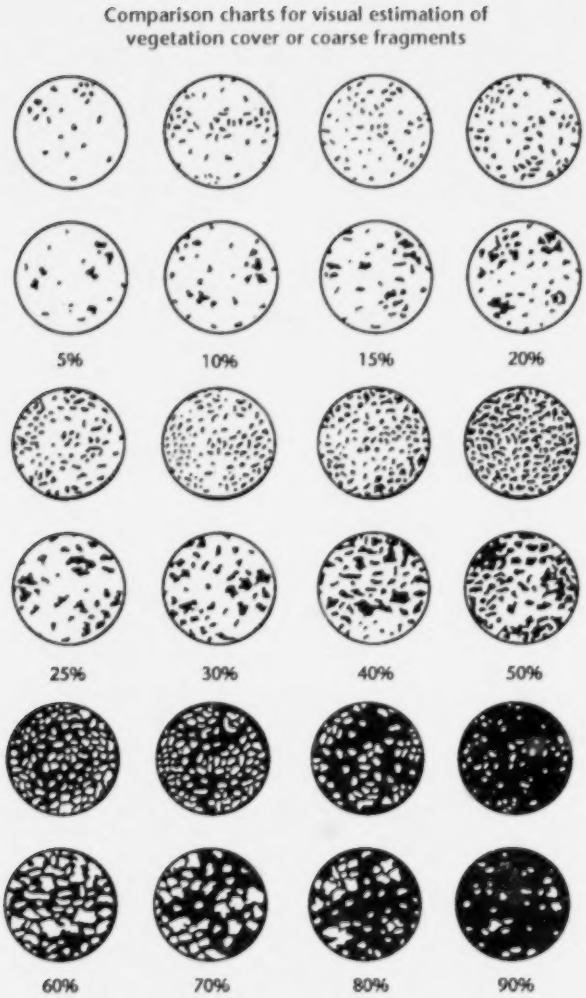


FIGURE 16 *Comparison charts for visual estimation of vegetation cover or coarse fragments (adapted from Terry and Chilingar 1955).*

PRESENT GROUND COVER (%), and EXPECTED FUTURE COVER (%) after tree canopy removal. In particular, record any extremely well-developed competing vegetation that may cause more serious problems to establishing conifers than would be expected within the site series.

> ***Note**: For the Interior or in very wet coastal areas of British Columbia, consider competition by native (e.g., pinegrass, reedgrass) and domestic grasses.*

23. COMMENTS

Note any expected problem vegetation in the area. Potential competitors are often more apparent before harvesting takes place. Consider shrub and tree species with high sprouting or suckering potential, or the presence of seed-banking species. Comment on potential invasion by competing vegetation and the expected hazard. Some regional ecology guides refer to competing vegetation complexes that commonly occur on various site series.

OVERSTOREY DATA

Use this section to describe the tree component of the site's vegetation. This data is useful when:

- supporting management objectives that are related to timber production and rotation ages, especially where cruise information is lacking;
- describing reserves; or
- supporting prescriptions for silvicultural systems other than clearcutting.

Omit this portion of the plot card if suitable cruise data support prescriptions for silvicultural systems other than clearcutting.

24. OVERSTOREY

Record the following information for a minimum of five recognized tree layers.

Layer	Description	Size definition
Vets	Veterans	40 years older than Mature
1(M)	Mature	12.5 cm dbh and larger
2(P)	Poles	7.5–12.49 cm dbh
3(S)	Saplings	1.31 m height to 7.49 cm dbh
4(R)	Regeneration	0–1.3 m height

If the layer is absent, record as "NIL."

Provide the following information *for each layer* described above (except age and height for Vets and dbh for the regeneration layer).

Species Percent: The species composition, indicated as a percentage. For recording, use the accepted species code and a percentage (e.g., Pl60 Sx30 At10).

Age: The average total age (in years) for all species within the layer (except for Vets).

Height: The average height (in metres) of the trees in the layer (except for Vets). Record to one decimal point.

dbh: The average diameter (in centimetres) at breast height (1.3 metres above the germination point) for all species within the layer (except for the regeneration layer, which has no dbh). Record to one decimal point.

Stems/ha: The total number of stems per hectare in the layer.

> ***Note:*** *ITEM 26 contains further detail about age, height, and dbh information for the mature layer.*

25. LAYER CONDITION / % ACCEPTABLE / COMMENTS

For each layer, assess occurrence of pathogens, vigour, damage, form, or other stand conditions, which affect the acceptability of these trees, or will have an effect on the prescription.

An assessment of vigour often considers features such as size, apparent rate of growth, size of leaves, abundance of flowers or fruit, and presence of chlorotic leaves. Assess vigour within a given site. The "average" plant growing reasonably well is considered to have good vigour.

For each layer, record the percentage of acceptable stems that may be considered for retention.

26. SAMPLE TREE DATA (mature layer)

Sample tree data are commonly collected where cruise data are either unavailable or inadequate to support a prescription. Record sample tree data for the mature layer (M) by SPECIES, including AGE, HEIGHT, and dbh. Record height in metres and dbh in centimetres, both to the nearest decimal point. CROWN CLASS, PERCENT LIVE CROWN, and 10-YEAR RADIAL GROWTH INCREMENT (to the nearest 0.1 cm) can also be recorded for these trees. Sample a minimum of three representative trees, with a minimum of two from the leading species and at least one from significant secondary species, especially when cruise data are unavailable.

Crown class: Use the following terms to describe these trees.

- ***Dominant (D)*** – crowns extending above the general level of the crown canopy
- ***Co-dominant (CD)*** – crowns within the general level of the crown canopy
- ***Intermediate (I)*** – crowns below, but still extending into, the general level of the canopy
- ***Suppressed (S)*** – crowns falling entirely below the level of the canopy

Percent live crown is the ratio of the length of the live crown expressed as a percent of the total tree height. The 10-year radial growth increment measures the width of the last 10 annual growth rings from the cambium towards the pith.

SOILS DATA

Correct soil description is critical for an effective SP. For areas where ground-based harvest systems are proposed, the most important data collected is the soil information necessary to complete the legally required soil disturbance hazard ratings. For these areas, consult any assessment reports prepared for the Forest Development Plan or SP (i.e., terrain stability field assessments, community watershed assessments, stream classification reports, gully assessments, etc.). Ministry of Environment soil survey maps and reports can help to explain the kinds of soil development and horizons found in the area.

At each detailed sample plot, dig a soil pit to a depth adequate to accurately assess the soil disturbance hazards. Use ITEMS 27 to 38 to record information relating to the soil pit. Record the actual depth of the soil pit for future reference or to defend the soil disturbance hazard ratings that are determined.

> ***Note**: For soil disturbance hazard assessments, information on depth, texture, and coarse fragment content is normally collected for all the horizons, except for those less than 5 cm in depth.*
>
> *Many of the interpretive keys used for soil disturbance hazard assessment require knowledge of soil conditions to 90 cm. Road cuts in or near the unit provide some information, and local knowledge is always important. However, where required by soil type, the only way to obtain this information is by digging to 90 cm. It is essential to do the soil disturbance hazard rating at the pit, to determine whether the site is*

between two hazard classes (e.g., Moderate versus High), and whether information is needed from the 60–90 cm depth.

27. FOREST FLOOR DEPTH (cm)

As a suggested minimum, provide the average total depth of the LFH layers in centimetres. It is preferable to list these layers separately and record an average depth for each. To get a good average depth of the layers, several "scratch pits" may be necessary.

> ***Note**: When determining the depth, do not include loose (non-layered) live moss, grasses, or leaves. This is important for the forest floor displacement hazard rating (ITEM 43).*

L (Litter): An upland horizon consisting of relatively fresh organic residues that are readily identifiable as to origin.

F (formerly, Fermented Layer): An upland horizon comprised of partly decomposed plant residues in which fragmented plant structures are generally recognizable as to origin.

H (Humus): Well-decomposed organic residue dominated by fine substances in which the original vegetative material is not usually discernible.

On very wet sites, the forest floor may be composed of organic soil layers. These organic layers are differentiated by the degree of decomposition of their organic materials, as described under SOIL HORIZONS (ITEM 29). Describe this material as an "organic" soil under ITEM 29 with descriptions for the Of, Om, and Oh layers.

More detailed LFH layer descriptors (necessary in using the Key to Identifying Humus Forms [Figure 18]) include the following:

Ln: An L horizon composed of newly accreted and essentially unfragmented plant residues.

Lv: An L horizon exhibiting initial decay and strong discoloration.

Fm: An F horizon in which plant residues are aggregated in a matted structure, with a tenacious consistence. Fungal mycelia are clearly a predominant biotic component; some faunal droppings may be present.

Fz: An F horizon in which plant residues are weakly aggregated with a loose or friable consistence. Faunal droppings are typically numerous and easily observed under magnification with a hand lens or binocular microscope; fungal mycelia may be present.

Fa: An F horizon in which plant residues are aggregated into a weak to moderate, non-compact matted structure. This is an intergrade between the Fm and Fz horizons, and as such, reflects properties of both, but neither fungal mycelia or faunal droppings predominates.

Hh: An H horizon dominated by fine substances with very few, if any, recognizable plant residues.

Hz: An H horizon dominated by fine substances with very few, if any, recognizable plant residues; faunal droppings constitute most of the fabric.

Hr: An H horizon dominated by fine substances, but that also contains recognizable plant residues, usually from fine roots, wood, or bark; typically dark reddish-brown hues.

28. HUMUS FORM

At a minimum, record as one of the three humus forms—Mor, Moder, or Mull (Figure 17). Humus form describes the condition and configuration of the LFH layers. The three humus form orders generally indicate an increasing nutrient availability. Therefore, Mor humus forms predominate on nutrient-medium and nutrient-poor sites, while Moder and Mull humus forms predominate on richer sites. Although optional, it is preferable to identify the humus form to the Great Group level (Hemimor, Rhizomull, etc.), as shown in the regional ecological field guides or in Figure 18. Refer also to *Towards a Taxonomic Classification of Humus Forms* (Green et al. 1993). Identifying the humus form to the Great Group level provides a clearer description of the type of humus form present. In turn, this confers a better understanding of site productivity, resistance to broadcast burning, and ability to sustain machine traffic.

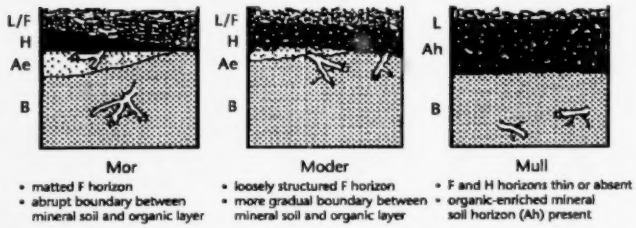


FIGURE 17 *Typical examples of Mor, Moder, and Mull humus forms and their distinguishing characteristics (from Lavender et al. 1990).*

Key to Humus Forms

1a. Well to imperfectly drained sites; humus form not saturated for prolonged periods
- 2a. Combined thickness of F and H horizons > 2 cm if Ah < 2 cm
  - 3a. > 50% thickness of F horizon(s) is Fm ..... **MORS (R)**
    - 4a. Decaying wood > 35% of organic matter volume in humus form profile ..... **Lignomor (LR)**
    - 4b. Decaying wood ≤ 35% of organic matter volume in humus form profile
      - 5a. F horizon > 50% of thickness of F and H horizon ..... **Hemimor (HR)**
      - 5b. Hh horizon > 50% of thickness of F and H horizons ..... **Humimor (UR)**
      - 5c. Hr horizon > 50% of thickness of F and H horizons ..... **Resimor (RR)**
  - 3b. F horizon(s) includes Fz and/or Fa ..... **MODERS (D)**
    - 6a. Decaying wood > 35% of organic matter volume in humus form profile ..... **Lignomoder (LD)**
    - 6b. Decaying wood ≤ 35% of organic matter volume in humus form profile
      - 7a. Fa horizon > 50% of thickness of F horizons; or Fm horizon present ..... **Mormoder (RD)**
      - 7b. Fz horizon > 50% of thickness of F horizons
        - 8a. F and H horizons greater than or equal to thickness of Ah horizon ..... **Leptomoder (TD)**
        - 8b. F and H horizons less than thickness of Ah horizon ..... **Mullmoder (MD)**
- 2b. Combined thickness of F and H horizons ≤ 2 cm and Ah horizon ≥ 2cm ..... **MULLS (L)**
  - 9a. Rhizogenous Ah horizon formed from decomposition of dense fine roots ..... **Rhizomull (ZL)**
  - 9b. Zoogenous Ah horizon formed through actions of abundant earthworms ..... **Vermimull (VL)**

1b. Poor to very poorly drained sites; humus form saturated for prolonged periods
- 10a. Combined thickness of F, H, and O horizons ≤ 2 cm and Ah horizon > 2 cm ..... **Hydromull (YL)**
- 10b. Combined thickness of F, H, and O horizons > 2 cm if Ah < 2 cm
  - 11a. Thickness of F and H horizons ≥ O horizons
    - 12a. F horizon(s) is Fm ..... **Hydromor (YR)**
    - 12b. F horizon(s) includes Fz and/or Fa ..... **Hydromoder (YD)**
  - 11b. Combined thickness of O horizons greater than F and H horizons
    - 13a. Of horizon > 50% of thickness of O horizons ..... **Fibrimor (FR)**
    - 13b. Om horizon ≥ 50% of thickness of O horizons ..... **Mesimor (MR)**
    - 13c. Oh horizon > 50% of thickness of O horizons ..... **Saprimoder (SD)**

FIGURE 18 *Key for identifying humus forms (B.C. Min. Environ., Lands and Parks and B.C. Min. For. 1998).*

SOIL HORIZONS

At a suggested minimum, record either Ah or Ae, and B, C, and R horizons (Figure 19). **Recording other horizon designations, as shown below, is optional.** Determine mineral soil horizons primarily by changes in colour, texture, and coarse fragments. Use the presence of carbonates (effervescence with acid), compacted layers, gleying, and mottles for further differentiation. Indicate, on the table provided for soil horizon descriptions, the depth of your soil pit in centimetres. This can be important for future reference. See ITEM 40, "Soil Classification/Association," for some management interpretations of common soil orders.

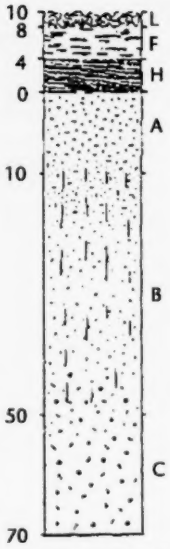


FIGURE 19 *Schematic soil profile (cm).*

29. HORIZON

- ***A horizon*** – Determine if the A horizon is Ah or Ae and provide the depth of the A horizon in centimetres. If the A horizon is absent or less than 0.5 cm deep, record depth as less than 0.5 cm.

  Ah: a surface mineral horizon containing an accumulation of organic matter. Usually darker coloured than the underlying horizons; often looks like garden/potting soil, and sometimes called "topsoil." The Ah layer will usually dominate the nutrient pool of the site and can influence the humus form classification and the Forest Floor Displacement Hazard rating.

  Ae: a surface or near-surface mineral horizon with most of the organic material, clays, and soluble materials leached out. Usually lighter coloured than the underlying horizons; appearing "bleached" or "ashy." (Ahe has properties of both, often has a "salt and pepper" appearance, or lighter/greyer than a "classic" topsoil).)

- ***B horizon*** – A mineral horizon with an accumulation or enrichment of clay, sesquioxides (iron and aluminum), or organic matter. If changes in a texture, coarse fragment, or calcium carbonate content occur within this horizon, it is useful to provide the description for each layer (Bm, Bmk, etc.). More detailed horizon descriptors for the B horizon might include the following:

  Bf: iron and aluminum enriched; reddish brown to reddish colour. (Bhf if also high in organic matter).

  Bt: clay accumulation; underlies a coarser-textured horizon (e.g., Ae); often blocky structure; clay coatings may be visible.

Bg: fluctuating water table or restricted drainage; often a bluish grey (gleyed) matrix with reddish mottles and granular structure.

Bm: weakly modified layer not showing the distinct characteristics of the above-mentioned B layers; yellowish brown to slightly reddish brown.

BC: transitional between B and C horizons.

- ***C horizon*** – An unweathered soil parent material.

- ***R horizon, Bedrock*** – This is consolidated bedrock that is too hard to break with the hand or to dig with a shovel.

- ***Horizon modifiers*** – For any of the mineral soil horizons described above, use the following modifiers:

  k: used with any horizon to indicate presence of carbonates (fizz with acid); most often used with B and m (e.g., Bmk) or C (see carbonates under ITEM 38).

  g: used with any horizon to indicate a fluctuating water table; usually bluish grey soil matrix with prominent reddish mottles.

  j: used with any horizon to denote a weak expression of the suffix it modifies.

- ***Organic soil*** – Organic horizons develop mainly from mosses, sedges, rushes, and woody materials under poor drainage conditions. They contain more than 30% organic matter.

  Of: fibric, poorly decomposed (i.e., large amounts of well-preserved fibre are readily identified as to botanical origin).

  Om: mesic, moderately decomposed (i.e., fibre is partly altered)

  Oh: humic, well decomposed (i.e., plant residues that for the most part have been transformed into humic materials). Folisols are an organic soil found on rock or skeletal material. Record layers within a Folisol as L, F, or H under forest floor depth (ITEM 27).

30. DEPTH (cm)

Provide the average range of depth of each of the horizons in centimetres from mineral soil top (0 cm) to bottom (e.g., Ae 0–8 cm; Bm, 8–25 cm). If the A horizon is absent or less than 0.5 cm deep, do not record, or record depth as less than 0.5 cm. Indicate depth and thickness of organic soil horizons in the same way as for mineral soils.

If the bottom of the BC horizon is not reached in the soil pit and you have enough soil disturbance hazard information, record as greater than the soil pit depth (e.g., BC 65–75+ cm). Likewise, indicate if the C horizon cannot be reached (e.g., "not found at 90 cm"); otherwise record the observed depth or range (e.g., C 65–95+ cm).

31. TEXTURE

Soil texture refers to the relative proportions of the sand, silt, and clay particles within a soil. Each has distinctive properties and a particular "feel," allowing a person to estimate the proportions in a sample of soil by hand texturing. Texture can be estimated very roughly from a dry sample. Clay materials are very hard; loam and silt materials are slightly hard to soft; and sand materials are loose grained. To be more precise, use the moist sample procedure for hand texturing, provided here, or given in the regional ecological field guide.

Table 2 outlines the general implications of soil texture for forest management.

Determine the soil texture for each horizon according to the relative amounts of sand, silt, and clay particles less than 2 mm in size. If two textures exist for one horizon, separate them into two horizons (e.g., Bm1, Bm2). If the texture varies in one horizon (e.g., SL to SCL), record the code as "SL / SCL." Use the keys in this handbook (Table 3, Figure 20) to improve your estimate. The texture triangle and keys in the regional ecological field guides may also help.

> ***Note**: The distinction between fine sandy loam and coarser sandy loam is important for forest management and necessary in the determination of soil disturbance hazards.*

32. PLASTICITY

While hand texturing samples from each mineral soil horizon, also determine its soil plasticity. Plasticity is the ability to change shape under the influence of an applied stress, and to retain the new shape after removal of the stress. Different soil plasticity requires different forest management considerations, especially when contemplating the soil's ability to withstand ground-based operations.

Use the following method to determine soil plasticity.

Thoroughly work water into the texture sample. Adjust the moisture content by rolling the sample in your hand or on a flat surface to reduce moisture, or by adding more water, until you can roll the smallest diameter for a 4 cm long roll (also referred to as a worm). Determine the plasticity class based on the criteria found on page 46.

TABLE 2 *General implications of soil texture for forest management*[a]

General implications of soil texture for forest management

Texture	Surface erosion (soil detachability)	Compaction/ Rutting	Available nutrients	Slope stability	Available water
LS or S	■ severe on steep slopes	❍	■ (▲ or ●)[b]	■ dry ravelling can be severe on steep slopes	■ very poor
SL	▲very steep slopes	●	▲ or ●	● dry ravelling on steep slopes	■ poor
Fine SL	■ severe on all slopes	▲	●	▲can flow	●
L	▲ moderately steep	●	●	●	●
SiL or Si	■ all slopes	▲	❍	▲ can flow/slump	❍
SCL	●	■ very high	❍	■ can flow/slump	●
CL	●	■ very high	❍	■ can flow/slump	●
SiCL	● (▲)[b]	■ very high	❍	■ can flow/slump	●
SC	❍	■ very high	❍	■ can flow/slump	▲
C	❍	■ very high	❍	■ can flow/slump	■
SiC	❍ (●)[b]	■ very high	❍	■ can flow/slump	●

Other important site factors to consider in addition to texture (vegetation can influence as well):

Surface erosion	Compaction	Available nutrients	Slope Stability	Available water
Climate	Climate	Coarse fragments	Climate	Climate
Slope %	Coarse fragments	Organic matter	Slope %	Slope %
Slope length/uniformity	Soil structure	Soil depth	Slope length/continuity	Slope position
Coarse fragments	Soil moisture	Seepage	Soil layers	Coarse fragments
Soil moisture	Forest floor depth	Climate (leaching)	Soil depth	Organic matter
Soil layers/depth		Unfavourable substrate	Soil moisture	Soil moisture
Soil structure			Bedrock features	Soil depth/layers
Seepage			Seepage	Seepage

a ■ = major problems, ▲ = concern, ● = may be a concern, ❍ = no concern b Depending on site condition

TABLE 3 *Guide for approximating soil texture class using hand texturing (modified from Cariboo Research Section)*

	Graininess			
Stickiness	Non-grainy (20% sand)	Slightly grainy (20–50% sand)	Grainy (50–80% sand)	Very grainy (80% sand)
Very sticky > 40% clay	silty clay	clay	sandy clay	—
Sticky 25–40% clay	silty clay loam	clay loam	sandy clay loam	—
Slightly sticky < 25% clay	silt loam or silt	loam[a]	sandy loam fine[b] medium coarse	—
Non-sticky < 10% clay	—	—	—	loamy sand or sand

Fine fraction separate	Diameter range (mm)	Properties
Clay	< 0.002	Very hard when dry; feels smooth and is very sticky when wet; feels smooth when placed between teeth
Silt	0.002–0.05	Slightly hard to soft when dry; powder is floury when dry; feels slippery and slightly sticky when wet; silt cannot be seen or felt as grains between thumb and forefinger, but can be felt as a fine grittiness when placed between teeth
Sand	0.05–2.00	All visible soil particles are sand; loose grains when dry; grainy when felt between thumb and forefinger; non-sticky when wet
Fine[b]	0.05–0.25	
Medium	0.25–0.50	
Coarse	0.50–2.00	

a Loam is a textural class exhibiting physical properties intermediate between those of sand, silt, and clay.

b Fine sandy loam is fine grainy; medium sandy loam is medium grainy; and coarse sandy loam is coarse grainy.

TABLE 3 *Continued*

Procedure for Hand Texturing

1. Obtain a small handful of soil, crush it in the hand, and remove coarse fragments (particles > 2 mm in diameter).

2. Gradually add water to the soil and work it into a moist putty with a soil knife or fingers. The correct moisture content is important. If the putty flows with the force of gravity, then it is too wet. If it crumbles when rolled, then it is too dry. It should have the consistency of a filler putty.

3. Determine the **stickiness** of the soil putty by working it between the thumb and forefinger, pressing and then separating the digits. Estimate clay content in this way (clay limits below are approximate):

   Very sticky: Soil putty adheres strongly to both digits and stretches distinctly before breaking (> 40% clay).

   Sticky: Soil material adheres to both digits and stretches slightly before breaking when digits pulled apart (25–40% clay).

   Slightly sticky: Soil material adheres to only one of the digits and comes off the other rather cleanly. The soil does not stretch appreciably when digits separated (< 25% clay).

   Non-sticky: Practically no soil material adheres to the thumb and forefinger (< 10% clay).

4. Determine the **graininess** of the soil putty by rubbing it between thumb and forefinger. Estimate sand content in this way (sand limits below are approximate):

   Non-grainy: Little or no grain detected (< 20% sand).

   Slightly grainy: Some grain detected, but non-grainy material (silt and clay) dominant (20–50% sand).

   Grainy: Sand detected as the dominant material. Some non-grainy material detected between sand grains (50–80% sand).

   Very grainy: Only material detected is sand. Little or no non-grainy material present (greater than 80% sand).

5. After stickiness and graininess are determined, use the hand texturing table as an approximate guide to the textural class of the soil. Use the textural triangle for a more accurate determination of the textural class.

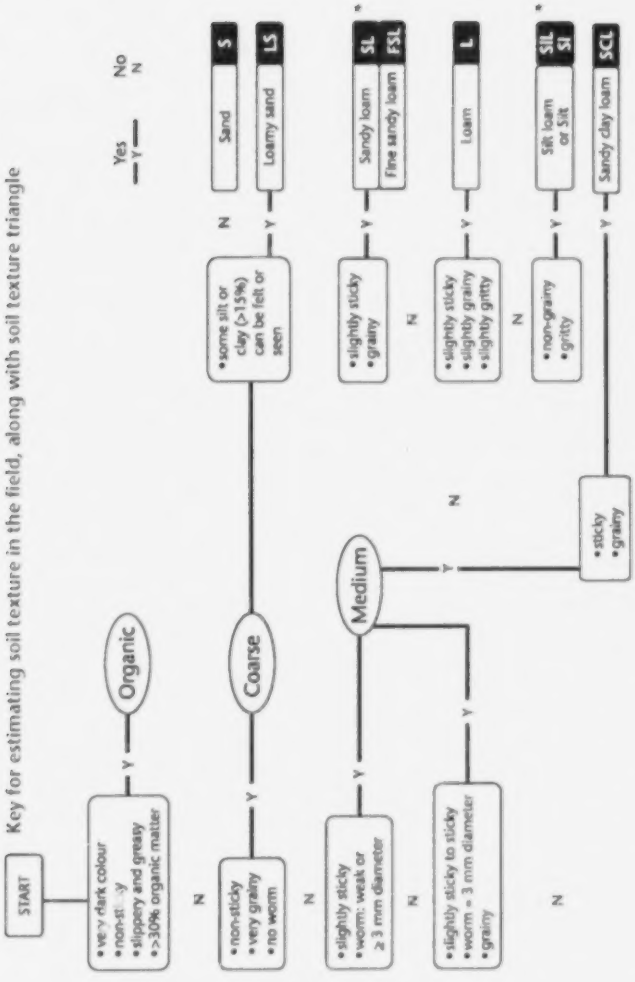
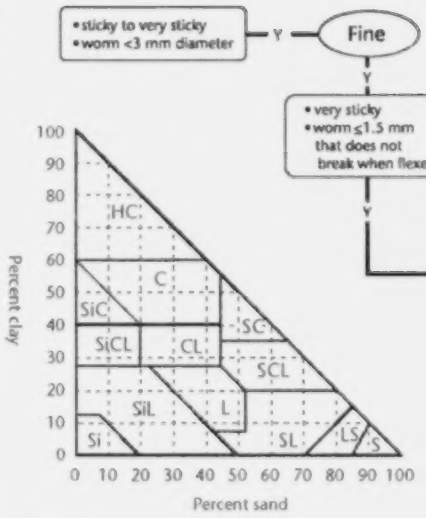
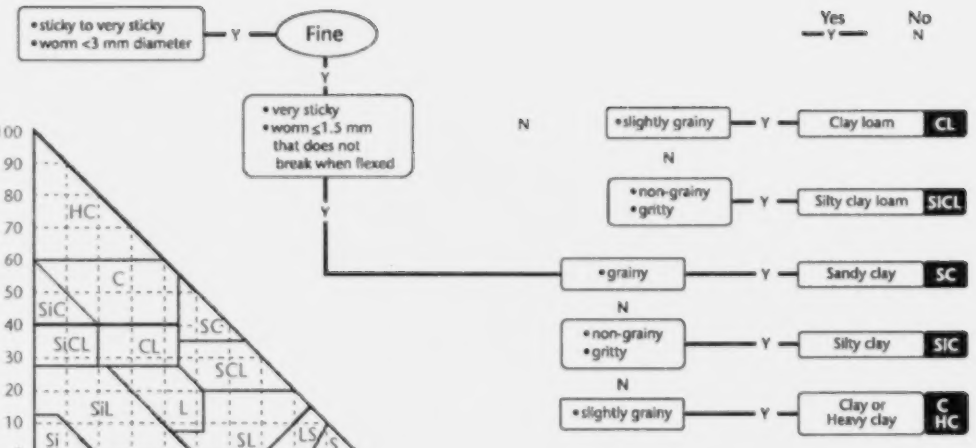


FIGURE 20 *Key for estimating soil texture in the field (adapted from Lloyd et al. 1990 and Walmsley et al. 1980).*

FIGURE 20 *Continued*



Soil texture triangle



* Silt feels slippery or soapy when wet; fine sand feels stiffer; like grinding compound or fine sandpaper. Fine sandy loam means the soil contains 30% or more fine or very fine sand, or more than 40% fine and very fine combined.

Code	*Plasticity (ability to change shape)*
NP	*Nonplastic* – a roll 4 cm long and 4 mm thick cannot be formed.
SP	*Slightly plastic* – a roll 4 cm long and 4 mm thick can be formed, but cannot support its own weight when dangled from the thumb and forefinger.
P	*Plastic* – a roll 4 cm long and 2 mm thick can be formed, but cannot support its own weight when dangled from the thumb and forefinger.
VP	*Very plastic* – a roll 4 cm long and 2 mm thick can support its own weight when dangled from the thumb and forefinger.

"Soil plasticity" as defined in the Canadian System of Soil Classification (Day 1983), provides a better framework for communicating soil behaviour at differing moisture levels, than do soil textural classes. Textural classes are not very diagnostic when predicting how a soil will behave mechanically at a given moisture level because:

- some texture classes have a very large range in clay content (e.g., 0–28% for silt loam);
- during the lab analysis to determine texture, soil samples are cleaned of some behavior influencing minerals (e.g., organic matter, calcareous material, and iron and aluminum oxides); and
- clays can contain a number of different clay minerals (with distinct cohesive properties such as plasticity and stickiness) that behave differently to mechanical forces.

Using soil plasticity classes will not alter the soil compaction hazard for a site, but highlights those soil conditions that are more likely to lead to compaction and rutting.

Table 4 outlines the general implications of soil plasticity for forest management.

33. COARSE FRAGMENTS PERCENT AND SIZE

Estimate the percentage of coarse fragments (> 2 mm) by volume (to the closest 5%) within each horizon using the visual estimation key (see Figure 16). Indicate the size of coarse fragments (CF) by type, as follows:

Type of CF (Code)	Diameter range
Gravels (G)	2–75 mm
Cobbles (C)	75–250 mm
Stones (S)	>250 mm (25 cm)

***Note**: Texture and coarse fragment content at various depths in the soil profile are required to complete different hazard ratings in various sections on the plot card. Therefore, be sure to complete all soil disturbance hazard ratings while you are at the soil pit.*

TABLE 4 *General implications of soil plasticity for forest management* [a, b]

	Nonplastic	Slightly plastic	Plastic	Very plastic
Compaction	○	●	▲	■
Rutting	○ (▲ if too dry)	●	▲	■
Ease of rehab	○	●	▲	■
Slope stability	○ (■ dry ravel)	●	▲	■
Surface erosion	■	▲	●	○
Available nutrients	■ or ▲	● (can be ▲)	○	○
Available water	■ or ▲	● (can be ▲)	○	○

a ■ = major problems, ▲ = concern, ● = may be a concern, ○ = no concern
b See Table 3 for other important site factors.

34. COLOUR / MOISTURE

Colour

Describe the colour of all mineral soil horizons. Light, medium, or dark are common descriptors. Examples of alternative descriptors include: (W) white, (G) grey, (Y) yellow, (Br) brown, (R) reddish or rust, (RB) reddish brown, or (Bl) black.

Colour is useful for interpreting the relative amounts of organic matter in the mineral soil, for classifying soils, and for prescribing topsoil handling and other soil rehabilitation operations. Light-coloured soils (e.g., white, light grey, yellow) are low in organic matter; medium-coloured soils (brown) are moderate in organic matter content; dark-coloured soils (e.g., black, dark brown, dark red) are high in organic matter.

Moisture

Describe the moisture content of the soil horizon at the time of sampling as (D) dry, (M) moist, or (W) wet. Indicate the moisture content using the following definitions for the condition of loose soil squeezed in the hand.

Dry: Will not form a cast; powdery dry or hard.

Moist: Forms a cast, but surface does not glisten when shaken or squeezed.

Wet: Forms a cast; surface glistens when shaken or squeezed (i.e., a film of water is visible).

Knowing the moisture content at the time of field sampling can help with planning seasonal soil operations and understanding site growth-limiting factors.

35. ROOTING DEPTH (cm)

Measure and record the distance (in centimetres) from the top of the mineral soil to the depth below which the abundance of roots decreases to a few fine and very fine roots (i.e., three or fewer per 2.5 × 2.5 cm surface). In shallower soils, this is usually to the bottom of the B horizon, or to a restrictive layer. This information may prove useful for rehabilitation plans.

Fine roots are 1–2 mm thick; very fine roots are less than 1 mm thick.

36. DRAINAGE

Record the drainage class of the plot as rapidly, well, moderately well, imperfectly, poorly, or very poorly drained. See Table 5 and Figure 21 for drainage definitions.

37. SEASONAL SOIL FACTORS (dates: dry, wet, frozen, snow)

Use the moisture descriptor (ITEM 34) to help calibrate the seasonal soil factors. Where seasonal conditions alter the operability or stability of the soils, describe the factor (e.g., moisture content, degree of frost, snow cover) and provide the applicable season(s) (e.g., late summer to early fall). Consult the Regional Soil Scientist or District Earth Scientist regarding local interpretations and experience with equipment trafficability. Some preliminary interpretations are provided in Curran (1999).

Consider the following factors during your data collection.

- Soil moisture conditions – Indicate the season in which you would expect the top 30 cm of the mineral soil to be dry or wet. Local experience and knowledge is important. If you are unsure of the season(s), use question marks. Dry does not have to be "powder dry."

  Practical experience, tempered with information from regional ecological field guides, can assist the assessment. For example, the climate description pages for biogeoclimatic subzones in the Nelson Region field guide

TABLE 5 *Soil drainage class (adapted from B.C. Ministry of Forests 1983; Agriculture Canada 1987)*

Drainage class	Definition	Mottling / gleying	Other
Rapidly drained	Soil moisture content seldom exceeds field capacity in any horizons except immediately after water additions	None	Often coarse textured or shallow to bedrock; normally occurs on steep slopes
Well drained	Soil moisture content does not normally exceed field capacity for a significant part of the year in any horizon (except possibly the C)	Usually none or ≥ 1m depth	Often medium textured; no seepage
Moderately well drained	Soil moisture exceeds field capacity for a small, but significant period of the year	Often faintly mottled in lower B and C horizons	Often medium to fine textured; seasonal seepage
Imperfectly drained	Soil moisture exceeds field capacity in subsurface horizons for moderately long periods during the year	Distinctly mottled in B and C horizons	Soils are generally gleyed subgroups of mineral soil orders
Poorly drained	Soil moisture content exceeds field capacity in all horizons for a large part of the year	Usually strongly gleyed	Soils generally of Gleysolic or Organic orders
Very poorly drained	Free water remains at the surface (or within 30 cm) for most of the year	Usually strongly gleyed	Soils generally of Gleysolic Order (peaty phase) or Organic order

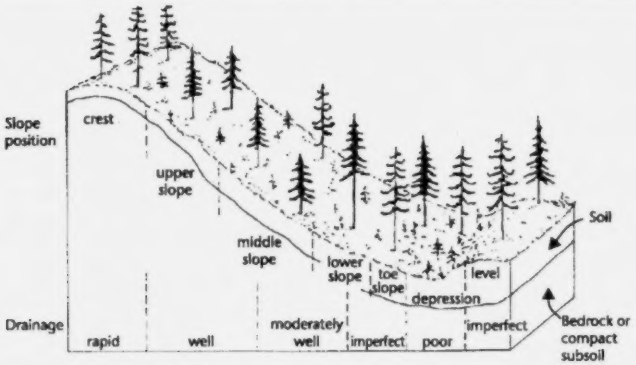


FIGURE 21 *Generalized drainage patterns and drainage classes for soils as influenced by slope position. Note that drainage classes may vary for a given slope position according to soil texture and coarse fragment content.*

(Braumandl and Curran 1992) provide interpretations of seasonal soil conditions, ranging from the driest to the wettest site series (e.g. "soils dry out for short to non-existent time periods"). An appendix contains further definitions of the time periods and depths. These interpretations are valuable because practical experience may be swayed by events such as "El Nino" winters.

In making an interpretation, it is important to observe how the soil behaves under moist and wet hand manipulation during hand texturing. Hand tests serve to mimic the forces applied to the soil by machine traffic (i.e., the combined forces of compression, shearing, and some vibration). Recognize that greatest compaction occurs under "moist" soil wetness, and wetter soils will rut; equipment is best kept to designated trails under these conditions. Local experience is important, see Curran (1999) for more information. Wet soil consistency, particularly how "plastic" the soil behaves (ITEM 32), provides an important basis for the harvesting strategies outlined in Curran (1999).

- Frozen ground – Indicate the typical winter depth of soil freezing for undisturbed soil (exposed surfaces freeze much deeper) and enter the season(s) between which you would expect this condition to prevail. (Refer to climate information provided in the regional ecosystem field guide.)

  One common misinterpretation is that soils remain frozen under snowpack. In the southern Interior of British Columbia and elsewhere, the soil is seldom frozen once a snowpack is over 30 cm deep; actual frozen depth will vary with snow density, layering, and temperatures.

  ***Note**: Many soils in the province do not remain frozen for very long. As soon as any snow cover accumulates, or warm weather melts the snow cover, the soil starts to thaw.*

- Snowpack – Indicate the typical winter snowpack depth and condition (granular or compressible), and enter the season(s) between which you would expect it to prevail.
  - Granular: snow that does not pack or consolidate easily (powdery to sugary or grainy; does not make a good snowball)
  - Compressible: snow near 0°C (water films present) that packs and consolidates well (makes a good snowball)

The regional ecosystem field guides supply some climatic information in the descriptions of climate or absolute moisture regimes.

38. UNFAVOURABLE SUBSTRATES

Record the presence of any unfavourable substrates by indicating "Y" for yes. Record the depth at which this substrate begins. If exposed or present, these substrates may produce unfavourable growing conditions for the new crop of trees.

Types of unfavourable substrates include the following:

Seepage (mottles/gleying): A condition indicative of excess soil water and therefore reduced soil aeration. A gleyed soil matrix (dull yellowish, blue, or olive colour) indicates a permanent water table; orange-coloured mottling indicates a fluctuating water table. The level of water during the dry period of the year approximates the level of a permanent water table.

> ***Note***: *Consider only for subhygric, hygric, and subhydric sites, as determined by vegetation (site series). Indicate whether the seepage you observe is seasonal rather than permanent. Record the depth from which water seeps into the soil pit. Keep in mind that, in many cases, water will fill a pit many hours after digging. It is unlikely that this depth of water will truly indicate the depth of the water table on certain sites.*

Unfavourable subsoils: Includes subsoil conditions that produce unfavourable growing conditions when exposed by displacement. Unfavourable subsoils include:

- ***Carbonates***: In arid and semi-arid areas (e.g., PP, IDF zones), soil development is limited by moisture, and salts (including lime) that have not been leached out of the developing soil profile. Even in humid areas with limestone-derived parent materials, calcium carbonate (lime) has often not been weathered and leached out of the profile. The resulting "calcareous horizons" in the soil has an unfavourable (alkaline) soil pH, especially for conifer nutrition. Often, these calcareous soils exhibit a white coating on coarse fragments or contain powdery white deposits (i.e., free lime). The presence of free lime is demonstrated by a fizz when fine soil particles (< 2 mm in diameter) are in contact with 10% HCl (hydrochloric acid, also known as muriatic acid). To make a 10% solution of HCl, dilute muriatic acid of known strength. Be sure to read instructions before diluting muriatic acid with water—it may be dangerous if improperly mixed. Buy muriatic acid at a builders' supply or hardware store.

  > ***Note***: *Record the depth at which 10% hydrochloric acid forms a low foam on fine soil particles (not just coarse fragments); this is referred to as a "moderately strong effervescence."*

- ***Water-restricting layer***: A substrate that restricts the downward flow of water, but not necessarily root growth. A water-restricting layer may indicate the presence of certain soil hazards. This substrate includes impermeable, dense, very compact or cemented layers (i.e., soils that are hard to dig with a shovel); bedrock; or a permanent water table (see "Seepage" above).

- ***Bt or dense parent material***: Bt refers to a B horizon enriched with clay. To restrict root growth, a Bt horizon must be at least 5 cm thick. Dense parent materials may include soils that are hard to dig with a shovel. Dense parent materials may include compact glacial till, and compact silty- or clay-textured glaciolacustrine deposits (see "Water-restricting layer" above).

- ***Sands / gravels***: Any materials with a sand (S) or loamy sand (LS) texture have very little silt and clay, and hence little nutrient or water-holding capability (less of a concern in wettest biogeoclimatic subzones). These unfavourable substrates commonly occur in glaciofluvial or recent fluvial deposits, but may also be derived from other parent materials.

- ***Fragmental (> 70% CF)***: Any soils with more than 70% coarse fragment content (i.e., fragments > 2 mm diameter). These soils can restrict rooting volume, and moisture and nutrient availability to plants.

Root-restricting layer: A substrate that restricts the downward growth of roots. It may include a layer of bedrock, or comprise impermeable, very compact or cemented layers, or a permanent water table.

For any restrictive layers identified, describe the specific type of restrictive layer, such as bedrock, compact glacial till, compact silty- or clayey-glaciolacustrine deposits, compact marine deposits, dense clay-enriched horizons, cemented horizons, etc. If seepage is apparent, indicate whether it is permanent or seasonal (e.g., fluctuating water table).

For further descriptions, refer to *Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook*.

OPTIONAL SOILS INFORMATION

ITEMS 39 to 42 may be useful for specific reasons noted under each item.

39. LANDFORM / PARENT MATERIAL

Use the diagrams in Figures 22 and 23, and the key in Figure 24, to identify the landform (parent material). Describe the parent material as: (O) organic, (R) bedrock, (C) colluvial, (M) morainal, (F) fluvial,

(FG) glaciofluvial, (W) marine, (D) weathered bedrock, (L) lacustrine, or (E) eolian. The type of landform can be further described as: (b) blanket, (v) veneer, (f) fan, (t) terrace, (p) plain, or (c) cone (see Table 6).

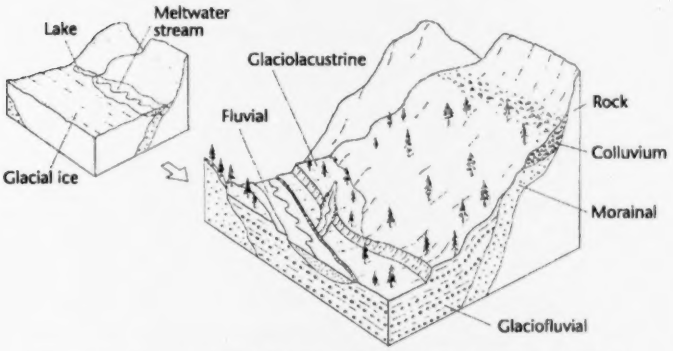


FIGURE 22 *Cross-sectional diagram of interior valley landforms (original hand sketch by Greg Utzig for B.C. Ministry of Forests, Nelson).*

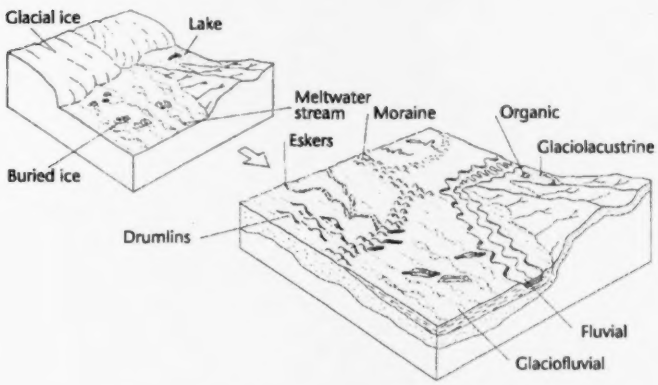


FIGURE 23 *Cross-sectional diagram of interior plain/plateau landforms (original hand sketch by Greg Utzig for B.C. Ministry of Forests, Nelson).*

Key to the identification of parent materials
START
Coarse fragments common in the deposit (particles larger than sand).
Y
N
Angular coarse fragments; Particle size variable; Loose deposits; Usually at the base of steep slopes; Coarse fragments usually touch each other.
Colluvial C
Y
N
Organic material >40 cm thick formed from decomposing vegetation on saturated sites (e.g., bogs, fens, swamps, and localized seeps in mountains).
Organic O
Y
N
Loose fine sand, or silt; Well sorted, not compacted, deposited by wind; Often a thin capping over another material; May have some buried coarse fragments.
Eolian E
Y
N
Layered and sorted silt, clay and sometimes fine sand; Lakebed deposits may be denser at depth; May have rare coarse fragments; Often terraced.
Lacustrine L
Marine W
Y
N
Generally subangular or variable angularity coarse fragments; Heterogeneous mix of all particle sizes; Often can feel some clay in subsoil (even if not in texture name); May be compacted or loose; Deposited by glaciers (e.g., till); Often looks like dense rice pudding with raisins (large rocks separated from each other); May have a few coarse fragments if derived from weak/fine bedrocks but some of these would not be from the local bedrock.
Morainal M
Y
N
Yes
No

FIGURE 24 *Key to the identification of parent materials (from Braumandl and Curran 1992, adapted from Lloyd et al. 1990).*

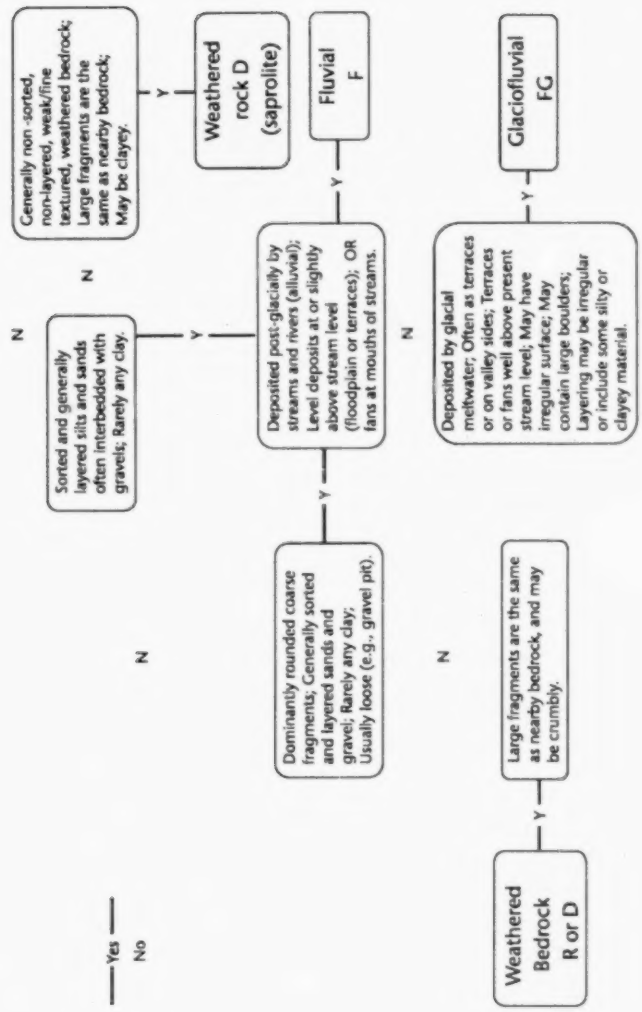

Yes
No
Weathered Bedrock R or D
Large fragments are the same as nearby bedrock, and may be crumbly.
Dominantly rounded coarse fragments; Generally sorted and layered sands and gravel; Rarely any clay; Usually loose (e.g., gravel pit).
Deposited by glacial meltwater; Often as terraces or on valley sides; Terraces or fans well above present stream level; May have irregular surface; May contain large boulders; Layering may be irregular or include some silty or clayey material.
Glaciofluvial FG
Deposited post-glacially by streams and rivers (alluvial); Level deposits at or slightly above stream level (floodplain or terraces); OR fans at mouths of streams.
Fluvial F
Sorted and generally layered silts and sands often interbedded with gravels; Rarely any clay.
Generally non-sorted, non-layered, weak/fine textured, weathered bedrock; Large fragments are the same as nearby bedrock; May be clayey.
Weathered rock D (saprolite)

FIGURE 24 *Continued*

TABLE 6 *Summary characteristics of parent materials and landforms*

Summary characteristics of parent materials and landforms

Parent material*	Symbol	Mode of deposition	Texture	Internal arrangement	Topography	Management implications
Fluvial	F	Water; streams and rivers	Variable, depending on mode of deposition	Stratified beds, coarse fragments, well rounded; loose material not compacted	Fans, floodplains	Active fans and floodplains are potentially subject to flooding and erosion
Glacio-fluvial	FG	Glacial meltwater	Boulders, gravels, and sands with minor silt and rarely clay	May or may not be well sorted; coarse fragments can vary from sub-angular to well rounded	Flat surface to steep terrace slopes; level or sloping terraces; floodplains	Gravel source; often nutrient poor unless seepage water is close to the surface (forest floor probably very important); droughty; poor cohesion can lead to dry ravel on slopes; rapidly drained; low water retention; scarp face unstable (ravels like gravel pit face)
Lacustrine	L	Lakebed	Fine sand, silt, clay; rarely any coarse fragments	Layered, particularly at depth	Old deltas and lakebeds	For both lacustrine and marine: unstable when wet; poor trafficability when wet; easily eroded; high water- and nutrient-holding capacity; poor road foundation
Marine	W	Marine	Same as lacustrine; may contain shells	Layered	Previously submerged coastal areas	

TABLE 6 Continued

Morainal	M	Laid down from the base, ends, sides, or melting surface of glacial ice sheets	Heterogeneous mixture of sand, silt, and at least some clay; various amounts of coarse fragments (usually do not touch each other)	Non-sorted; generally sub-rounded to sub-angular coarse fragments; may be compacted at depth	Extensive	Properties are variable and depend on texture and coarse fragment content; generally provides a good foundation and can have stable cuts if compact (dense) till; can make good road sub-grade and surface grade
Colluvial	C	Moved by gravity (e.g., talus, avalanche deposits)	Variable: coarse fragments usually very angular and often touch each other	Loose, randomly sorted; often only one rock type	Steep slopes and lower slopes/toe	Steep slopes may be unstable; forest floor probably very important; often nutrient poor and droughty
Eolian	E	Deposited by wind or by volcanic eruptions in local areas	Sands and silts; coarse fragments covered by veneer, unless volcanic pumice	Loose; may be cross-bedded, well sorted	Variable: valley bottoms to steep slopes	If denuded, is subject to wind and water erosion; properties of underlying parent material important if shallow deposit
Organic	O	Decomposing vegetation on saturated sites	Fibric, Mesic, and Humic	—	Saturated depressions; bogs, swamps, fens	Poor trafficability; poor road foundation, even when drained; poor aeration; cold, wet
Bedrock	R	—	See bedrock key, Figure 26.	—	—	—

a Surface expression subscripts:

b - blanket > 1 m t - terrace c - cone
v - veneer < 1 m f - fan p - plain

Parent material surface expression (i.e., Mb, Mv, Cb; alone or in complexes)

indicate complexes as: Cv = Mb (roughly equal proportions)
Cv/Mb (Cv>Mb [2:1 or 60–40%])
Cv//Mb (Cv>>Mb [3:1 to 9:1])
Layered deposits: indicate as $\frac{Cv}{Mb}$

This information is important for interpreting instability, particularly when interpretation is based on experience in a local area.

Various other references (e.g., Keser 1976; Ryder and Howes 1984; Howes and Kenk 1988; and regional ecological field guides) will help you identify and classify landforms.

40. SOIL CLASSIFICATION / ASSOCIATION

Identify and classify soils to the Soil Order (e.g., Podzol, Gleysol) and Great Group (e.g., Humo-Ferric Podzol) level. Figure 25 contains the necessary classification information. See also the *Canadian System of Soil Classification* (Agriculture Canada 1987). Knowledge of local soil classification may be helpful in making management interpretations and may be needed for herbicide permit application.

If available, add the soil association. Locate this information in a soil map legend or report, and record by soil association name (e.g., Wycliffe Soil Association). Knowledge of the local soil associations and associated landforms is useful for the prescription process and communicating local experience.

Some general interpretations for soil orders follow.

- ***Organic soils*** – Very cold, wet soils; includes Humisols, Mesisols, Fibrisols, and Folisols; very sensitive to disturbance; for Folisols, the forest floor is extremely important; sometimes this is the only soil on the site, and therefore very sensitive.
- ***Chernozems*** – Grassland soils; grasses compete intensely for water; usually droughty, may have summer frosts; often calcareous at depth.
- ***Gleysols*** – Cold, wet soils; shallow rooting; windthrow problems common. For Luvic Gleysols, see also Luvisols, below.
- ***Luvisols*** – Usually dense "clay pan" at depth (unfavourable subsoil); often very high compaction hazard; may have suspended water table and associated windthrow, cold soil, and slope stability problems; may be calcareous at depth.
- ***Podzols*** – Occur in humid climates (wet belts or ESSF zone); if thick Ae (e.g., > 5 cm), may be very acidic and nutrient-poor.
- ***Brunisols*** – Less developed soil; more alkaline ones (e.g., Melanic or Eutric Brunisols) are often calcareous at depth. If Brunisols found on steep slopes where Podzols are expected, see Regosols, below.
- ***Regosols*** – Younger soils, either from extreme climates (e.g., desert-like), or (more commonly) recently deposited or exposed parent material (e.g., floodplains, old landslides). If found on steep slopes where more developed soils are expected, evaluate slope stability concerns even if not obvious (see ITEM 46, "Indicators of Potential Slope Instability").

41. SURFACE ORGANIC MATTER / SOIL CHARACTERISTICS

Describe the organic matter on the surface of the forest floor and calculate the percent cover of exposed boulders, rock outcrops, and mineral soil.

This information is useful when selecting harvesting and site preparation equipment. Coarse woody debris can limit the use of some site preparation equipment. The presence of large amounts of exposed mineral soil may be important in site preparation and planting decisions, as well as assessments of the sensitivity or significance of the forest floor.

Assess and consider the importance of organic matter and associated nutrients and biology. On some sites, preserving organic matter levels should be considered in the SP (e.g., in grass-dominated open-growing stands in drier biogeoclimatic zones, such as BG, PP, IDF, and MS). Coarse woody debris is an important source of forest floor organic matter; it provides sites for nitrogen fixation and critical water storage.

- Coarse woody debris – Note whether it is standing or down, sound or rotten. Is snag preservation important for wildlife? If so, note how much is recommended.
- Rotting wood – This is partially or completely incorporated into the forest floor. Record the quantity present and consider its importance. In drier ecosystems, much of the organic matter in the forest floor comes from coarse woody debris. Note any recommendations.
- Exposed soil or rock – Note whether the forest floor is naturally discontinuous. If so, determine the Forest Floor Displacement Hazard. Will boulders, sand, or rock outcrops limit equipment operations? In addition, will natural disturbances create enough planting or regeneration opportunities?

42. COARSE FRAGMENT BEDROCK / LITHOLOGY

Note the general rock type(s) of the coarse fragments or bedrock (e.g., granite). Using the key provided (Figure 26), describe the crystal size, hardness, and colour (from a fresh face on the rock). If available, use local bedrock keys and geology information.

Some bedrock types can indicate problems—for example, serpentine and phyllites, as well as some shales and schists, are often unstable; phyllites weather readily to clays; and areas of limestone and calcareous siltstone are difficult to revegetate. In the "Indicators of Potential Slope Instability" section (ITEM 46), note whether important lithological or bedrock features are present that may affect forest management activities (e.g., bedding planes that are similar to the general slope angle, or extensive fracturing and weathering). These features can potentially affect the stability of the slope, or the stability of road cuts and fills.

FIGURE 25 *Soil classification key to the Great Group level (adapted from Lloyd et al. 1990).*

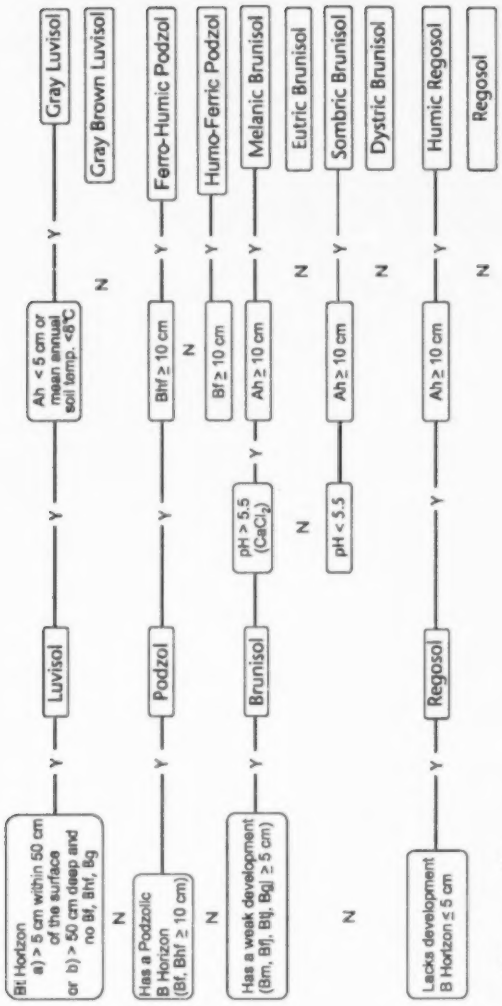


FIGURE 25 *Continued*

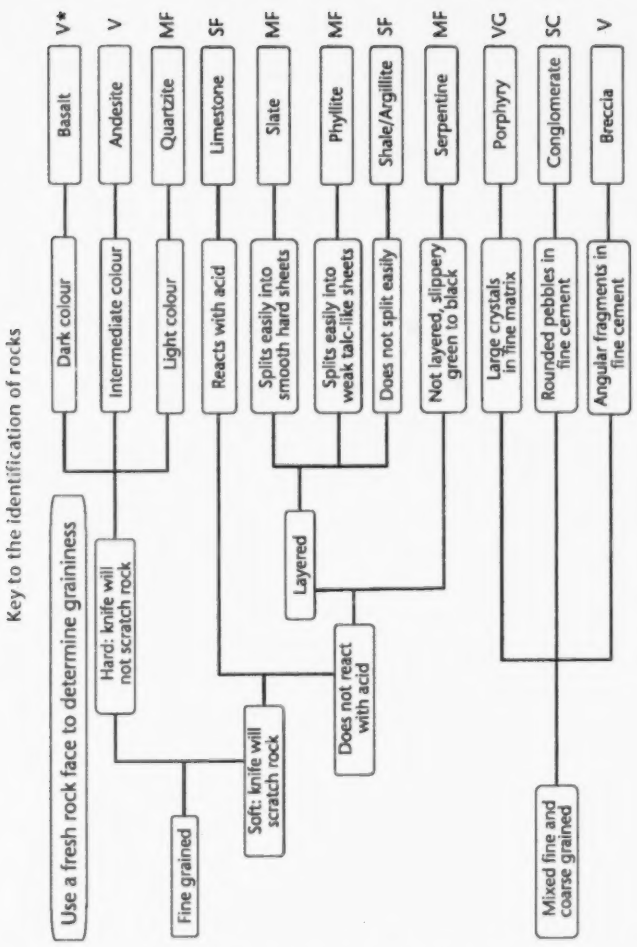


FIGURE 26 *Key to the identification of rocks (adapted from B.C. Department of Mines and Petroleum Resources 1970) (Continued on next page).*

* V - volcanic; L - limestone; SC - sedimentary coarse; SF - sedimentary fine; MF - metamorphic fine-medium; MC - metamorphic coarse; G - granitic

FIGURE 26 *Continued*

SOIL HAZARD ASSESSMENT

The *Operational Planning Regulation* requires an assessment of soil disturbance hazards for areas under a silviculture prescription that will be harvested by methods other than cable or aerial. Filling out the soil hazard assessment section of the plot card for all other areas may still be advisable. For instance, the Mass Wasting Hazard section (for the Interior only), similar to ITEM 46 ("Indicators of Potential Slope Instability"), may help to identify ("red flag") problem slopes, which can be missed by terrain mapping. The *Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook*, referenced in the *Operational Planning Regulation*, contains the necessary assessment procedures. These procedures are summarized below for the soil hazard sections contained on the plot card (FS 39A).

After digging a representative soil pit, determine the rating for Soil Compaction, Soil Displacement, and Soil Erosion. Although not required by legislation, Forest Floor Displacement, and (in the Interior) Mass Wasting Hazards may be assessed at little, or no extra cost; these hazards are referred to in local guides for construction and rehabilitation of excavated and bladed trails (e.g., Curran 1999) and root rot treatments (e.g., Norris et al. 1998).

For all hazard assessments, the classes are: very high (VH); high (H); moderate (M); and low (L). Where variability in site conditions results in a range of values that span two hazard classes, the combination should be indicated (e.g., moderate–high).

The soil hazard assessments should be completed at the pit. This will ensure that ratings are reviewed and confined on site, and any important management considerations are contemplated while the surveyor is still in the field. To assist with the rating process, the Soil Hazard Assessment section of the plot card (FS 39A) is adjacent to the soil pit information already collected. For the information necessary to complete each hazard assessment, refer to the item number on the plot card.

Precipitation factors for biogeoclimatic subzones by forest region are needed for some of the hazard assessments (see Appendix 4). This information is also found in the *Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook*. More discussion of each hazard and the development of strategies to deal with them is contained in Curran (1999).

43. SOIL HAZARD ASSESSMENT

The *Operational Planning Regulation* requires that the SP must specify the hazards for soil compaction, soil erosion, and soil displacement for any area identified in a forest development plan that will be harvested by a method other than cable or aerial.

Compaction and Puddling Hazard: Determine the applicable moisture regime by referring to ITEM 13. Soils with xeric to mesic moisture regimes, or subhygric with a forest floor H horizon (ITEM 27) less than 20 cm thick, are rated separately from subhygric soils with a forest floor H horizon greater than 20 cm thick, or where the soil moisture regime is hygric or wetter. For the moisture regime selected, circle the dominant coarse fragment content (ITEM 33) and the most sensitive texture (ITEM 31) for the top 0–30 cm of mineral soil. When a pronounced textural change occurs (i.e., ≥ 5 cm) within the upper 30 cm (e.g., silty over sandy soil), use the more limiting soil texture. Circle the hazard rating.

"Clayey" refers to all textures with clay in the name (i.e., SC, SiCL, SCL, CL, SiC, and C). For the purposes of this assessment, fSL, "fine sandy loam" means that the soil contains 30% or more of fine or very fine sand, or more than 40% of fine and very fine sand combined. Fine sand is 0.25–0.10 mm in diameter, very fine sand is 0.10–0.05 mm in diameter; these generally represent the limits of visible particles.

Compaction is the increase in soil density that results from the rearrangement of soil particles in response to applied external forces. Puddling is the destruction of soil structure that results from working wet soil. Both lead to loss of macroporosity, reduced water infiltration, increased resistance to root penetration, and reduced aeration, which all potentially affect slope hydrology and soil productivity.

Soil Displacement Hazard: Circle the average slope percent (ITEM 11). For gullied (ITEM 19) or hummocky terrain (ITEM 16), additional points are assigned *only when these features are present.* Referring to ITEM 38 (unfavourable substrate), note the subsoil condition and depth. If more than one unfavourable substrate is present, choose the condition closest to the surface that results in the highest point value. Add the total points and circle the hazard rating.

Organic soils with 40 cm or more of wet, organic material are rated as "High Displacement Hazard." Forest floors over bedrock or skeletal materials (e.g., Folisols) are rated as "Very High Displacement Hazard."

Soil displacement is the mechanical dislocation of soil materials by equipment and by the movement of logs or trees. It involves excavation, scalping, exposure of underlying unfavourable materials, and burial of surface soils. This can result in nutrient redistribution, loss of available nutrients, and potential losses in soil productivity. Soil displacement can also affect slope hydrology by exposing or diverting seepage water and runoff.

Soil Erosion Hazard: Determine the precipitation factor for the BEC subzone by referring to Appendix 4. Circle the applicable site condition. Referring to the plot card ITEMS 11, 17, and 38, circle the appropriate description. Use the most limiting texture and coarse fragment combination in the top 15 cm of mineral soil (i.e., if two contrasting textures or coarse fragment contents occur at this depth, use the one with the highest point rating). Apply the same principle for the subsoil texture (16–60 cm depth). Add the total points and circle the hazard rating.

Gently sloping areas with long uniform slopes may rate a high soil erosion hazard; given the right combination of conditions, substantial erosion can occur on these sites.

Soil erosion is the wearing away of the surface soil by water and wind and includes splash, rill, and gully erosion. It causes both on-site effects (e.g., soil loss, nutrient loss, productivity loss) and off-site effects (e.g., lower water quality, sedimentation, habitat deterioration). Splash erosion occurs when raindrops transport soil particles. Rill erosion occurs when surface water moves into small depressions, gains depth and velocity, and transports soil particles. Gully erosion occurs when water movement increases in depth, volume, and velocity. Two predominant types of gullies occur.

- V-shaped – Form in soils that are either shallow or uniformly erodible with increasing depth.

- U-shaped – Form in less erodible soils that overlie more erodible soils (e.g., fine textured B horizon over a sandy C horizon), or form in dense or partially cemented soils (e.g., silty lacustrine, calcareous glaciofluvial deposits).

OPTIONAL HAZARDS

Forest Floor Displacement Hazard: This optional assessment helps both the surveyor and the prescriber recognize the relative importance of the forest floor on a given site. To use the field card, circle the applicable site conditions, noting that "Soil Matrix" is a combination of "Texture" and "Coarse Fragments." To determine the soil matrix rating, use the first or top mineral soil horizon that is 15 cm (or more) thick; otherwise use the thickest layer in the top 30 cm of mineral soil. For example, if the Ae horizon is 5 cm thick followed by a Bf horizon of 18 cm, use the texture and coarse fragment content within the Bf to determine the soil matrix rating. Alternatively, if an Ah horizon of 15 cm is underlain by a Bm horizon of 20 cm, use the Ah to determine the rating.

Use the same depth to unfavourable substrate as in the soil displacement hazard assessment.

When recording slope percent for this hazard category, hummocky or gullied terrain is rated equally with slopes greater than 60% because of the increased likelihood of mechanical displacement. Add the total points and circle the hazard rating.

Forest floor displacement is the mechanical dislocation of the upper organic materials by equipment and movement of trees or logs. It involves excavation, scalping, mineral soil exposure, and burial of the forest floor. It can result in nutrient redistribution and potential losses in soil productivity.

Effects on soil productivity range from beneficial to detrimental, depending on site factors (e.g., mineral soil characteristics) and degree of forest floor displacement (e.g., how far the displaced forest floor is from the seedlings).

Refer to Appendix 5 for more information on this hazard.

Mass Wasting Hazard (Interior only): This optional assessment helps the surveyor identify areas that call for special consideration during construction of bladed structures or ground-based operations. To use the field card, for all Interior sites, use both parts A and B. If dry ravelling is not a concern, indicate this by recording "n/a" (not applicable) in Part A. Dry ravelling occurs on steep slopes consisting of non-cohesive, granular, and fragmental materials.

In Part B, cutslope and fillslope failure hazard is assessed. Circle the applicable site conditions. For moisture regime, assign fractional ratings, if required, as long as this is defensible. Use the most limiting texture in the soil profile or use the predominant texture grouping that overlies a water-restricting layer (i.e., whichever is rated highest). Add the total points and circle the hazard rating.

The Mass Wasting Hazard is the highest rating obtained from either Part A or Part B. Similar to "Indicators of Potential Slope Instability" (ITEM 46), Mass Wasting Hazard assessment also helps to call attention to areas of concern. ***If the Mass Wasting Hazard is "Very High," seek further advice from an appropriately qualified slope stability specialist before proceeding with development of the prescription.***

If gully systems greater than 5 m deep are present, conduct an individual Mass Wasting Hazard assessment on each gully system.

Mass wasting is erosion by detachment and transportation due to gravity. In the Interior, mass wasting is a common concern in the wetter BEC zones, such as the ICH, the wetter SBS and ESSF subzones, and the BWBS, but it can be a concern in any zone.

Determining the mass wasting hazard assesses susceptibility to small, disturbance-related slope failures: it is not the same as landslide likelihood, which is determined using the procedures specified in the *Mapping and Assessing Terrain Stability Guidebook*. Mass wasting hazard refers primarily to small-scale failures that cause mainly on-site degradation, while landslide likelihood refers to larger events that may possibly cause off-site impacts. The two hazards are correlated—a very high mass wasting hazard may indicate a potentially unstable slope. In addition, small disturbance-related slope failures can lead to larger landslides through drainage diversion or failure of "stacked" excavations up a hillside, such as those used in switch-back road construction.

Several landform types are prone to mass wasting problems, such as:

- glaciofluvial terraces (e.g., stratified sand and gravel) with thin silt or clay layers (slump);
- glaciolacustrine terraces (slump);
- coarse glaciofluvial deposits with slopes close to the angle of repose (dry ravel);
- steep colluvial deposits (dry ravel);
- debris-filled channels and confined snow avalanche tracks (debris torrents); and
- steep morainal deposits (debris avalanches).

Refer to Appendix 6 for more information on this hazard.

44. SOIL HAZARD SUMMARY

From each of the Compaction, Soil Displacement, Soil Erosion, Forest Floor Displacement, and Mass Wasting Hazards, enter the points (excluding Compaction) and rating in the summary table provided.

45. COMMENTS / SOIL PIT

Provide further clarification, where required, on information related to ITEMS 27 to 44, inclusive. Indicate the item number to which these comments apply. Circle the item number on the form to alert the reader that further information relating to this item can be found in the "Comments" section. A sketch of the soil pit can be helpful in describing soil layers to persons responsible for construction and rehabilitation of temporary access structures.

46. INDICATORS OF POTENTIAL SLOPE INSTABILITY (COAST AND INTERIOR)

Examine the site for any historic or active indicators of instability problems, and record the types of features, if any, by checking *all* the indicators observed. Some of these features by themselves may not be cause for concern, for example, curved tree butts (pistol-butts) may indicate snow-creep; mixed or buried soil profiles may result from windthrow; scarred trees on the edges of a gully may be windthrown; fresh rocks on hill slopes may result from grizzly bear digging or blasting upslope. However, they may be a concern when other factors are also present.

Overlooking potential slope instability can result in development decisions that greatly increase the risk of slides or erosion events that may create unacceptable damage to productive forest land, water quality, property, and even risk to human life. The primary purpose of the list of slope stability indicators is to assist the surveyor in identifying possible terrain instability that may not be shown by mapping at the FDP stage. Information in the FDP is normally based on terrain stability mapping at the detailed or reconnaissance level. Depending on the survey intensity level (TSIL) of this mapping, it is likely that small-scale features may have been missed. The typical number of field checks during detailed terrain mapping is usually no greater than one per square kilometre, and the smallest mappably polygon is about 4 ha. Also, some small-scale terrain instability features are not visible on air photos as they may be obscured by forest cover.

The presence of the following slope failures indicates a serious slope instability problem.

- tension cracks (fractures) on hillsides (Figure 27)
- old slide scarps or slump headwalls (Figures 27 and 28)
- existing landslide tracks or initiation zones (Figures 27 and 28)
- scoured stream channels or gullies (Figure 29)
- debris deposits in channels (Figure 29)
- debris deposits on or below open slopes (Figure 29)
- tilted or jack-strawed trees from soil movement
- seral vegetation succession on a slide (e.g., slide alder; not to be confused with snow avalanches)

If a TSFA has not been required for a cutblock based on terrain stability mapping, and indicators of terrain instability are present, then FPC regulations require that a TSFA be conducted. The forester responsible for a FDP or SP must determine whether features observed by field crews constitute an indicator of potential slope instability, as defined by FPC regulations, and if so, to ensure that a TSFA is conducted. If in doubt, the forester should have

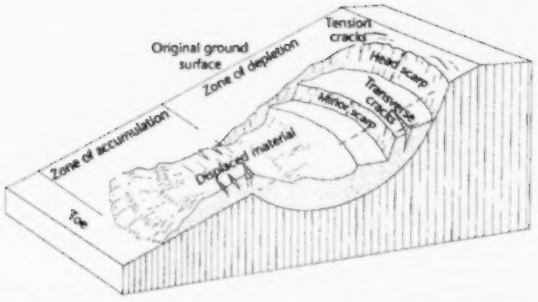


FIGURE 27 *Slump/earth flow features (adapted from Varnes 1978).*

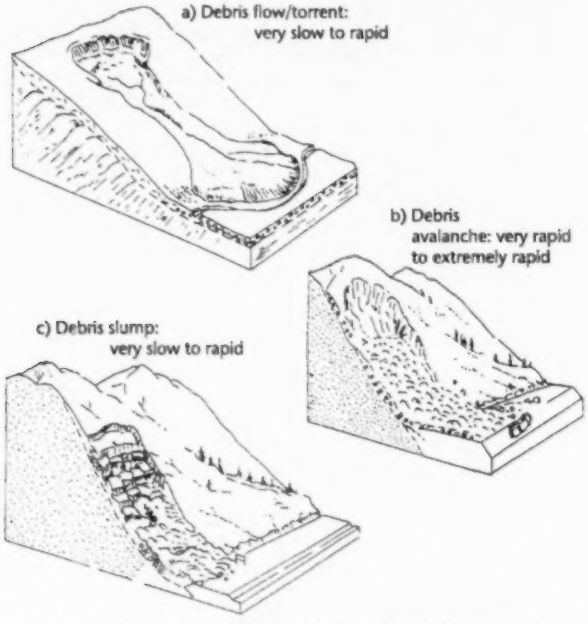


FIGURE 28 *The three principal types of shallow slope failures in surficial deposits (Varnes 1978).*

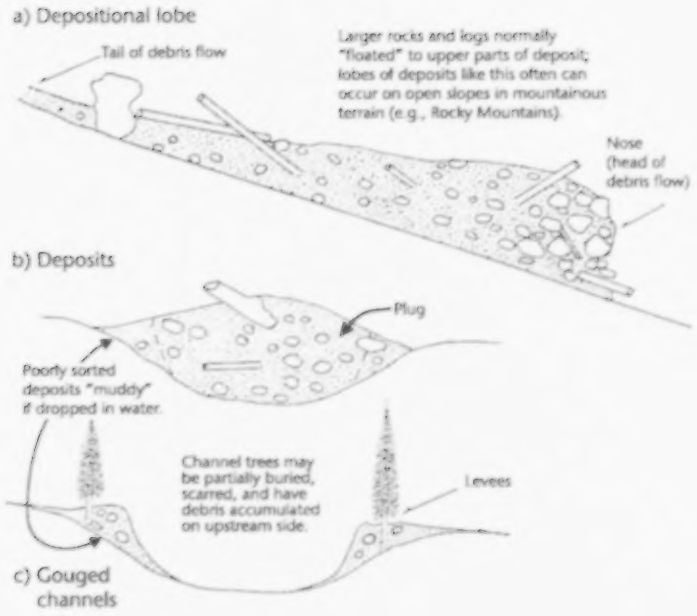

a) Depositional lobe
Tail of debris flow
Larger rocks and logs normally "floated" to upper parts of deposit; lobes of deposits like this often can occur on open slopes in mountainous terrain (e.g., Rocky Mountains).
Nose (head of debris flow)
b) Deposits
Plug
Poorly sorted deposits "muddy" if dropped in water.
Channel trees may be partially buried, scarred, and have debris accumulated on upstream side.
Levees
c) Gouged channels

FIGURE 29 *Characteristics of a moving debris flow: (a) longitudinal section showing variable concentration of solids and vertical velocity gradients in different parts of the flow; (b) cross-section through debris flow in motion, indicating central plug and marginal dead zones; and (c) cross-section of torrent channel after passage of debris flow (note debris left behind by the flow) (adapted from Eisbacher and Clague 1984).*

a TSFA done, or should seek the advice of a qualified registered professional with expertise in terrain stability, to help decide if a TSFA is required.

> ***Note**: If there are any slope instability indicators in Coastal areas, also refer to* A Guide for Management of Landslide-Prone Terrain in the Pacific Northwest *(Chatwin et al. 1994).*

Seven broad categories have been assigned to instability features. These are landslide, vegetation, slope, soil, bedrock/rockslide, road, and gully features.

1. LANDSLIDE FEATURES

Recent landslide scars: Obvious evidence of downward and outward movements of slope materials (e.g., debris avalanches, debris flows, or slumps); usually associated with a fast rate of falling; strong indicator for potential slope instability. Debris flow is a type of landslide characterized by water-charged material flowing rapidly down a pre-existing channel; also known as debris torrent or mudflow (see Figures 28 and 29). A slump is a type of landslide characterized by the curved backward rotation in a mass of soil (see Figure 28).

Revegetated landslide scars: Vegetation has re-established on a landslide, as described above; strong indicator for potential slope instability.

2. VEGETATION FEATURES

Partially revegetated strips: Seral vegetation is oriented up and down slopes (but not due to snow avalanches), or is oriented with slope features; see "Slope Features," below.

Jack-strawed trees, split trees: Trees tilting in one or a number of directions provide clear evidence of slope movement (unless obviously attributed to root rot or windthrow). Split trees have stumps/boles that have cracked or split due to soil creep.

Linear strips of even-aged timber: Younger trees are oriented up and down slopes (not due to avalanches), or are oriented with slope features; see "Slope Features," below. Veterans are usually lacking.

Curved or sweeping (pistol-butt) trees: Curved trees are good indicators of slope movement (temper this interpretation in areas of heavy snowfall). A good rule of thumb: if the curve occurs only at the very bottom (i.e., a true "pistol-butt"), snow rather than slope instability might be the cause; if the curve sweeps gradually up the tree, this suggests an ongoing soil creep problem.

Wet site vegetation on slopes > 50%: Moisture-indicating plants on steep slopes often provide strong evidence of high groundwater levels, which will

influence slope stability. Some of the most common plants to look for are alder, horsetail, devil's club, cow parsnip, and skunk cabbage.

3. SLOPE FEATURES

Landslide debris piled on lower slope: An accumulation of loose, predominantly coarse-grained soil and rock fragments, sometimes occurring with large organic material, such as limbs and trunks of trees, which is mixed together in an unsorted fashion; found on lower slopes or depositional lobes (Figure 29), or piled on gentler slope segments or lower slopes; by itself, a strong indicator of slope instability. Often revegetated or reforested.

Tension fractures: Tension fractures are cracks in the ground surface caused by tensile stresses; often found at the head of a landslide (Figure 27) and are a serious indication of soil movement; may appear fresh (e.g., sharp edges, roots stretched across crack, trees or stumps split) or older (e.g., steps or gaps running across slope, bigger roots bridging or split across these fractures).

Numerous springs at toe of slope, sag ponds: Areas of concentrated subsurface water flow or ponding water on benched or stepped slopes are potential sites of active, unstable ground.

Curved depressions: Small, spoon-shaped depressions occur in the slope (e.g., the soil appears to have discharged from a miniature head scarp [Figure 27]); trees look like they are riding downslope on "islands"; most of the soil associated with windthrow ("tree-churns") have moved downslope. A scarp is a steep surface directly below the undisturbed ground above a landslide (caused by the landslide).

Shallow, linear depressions: Areas of concentrated surface and subsurface water flow oriented up and down the slope. These landslide scars or erosion channels on hill slopes are common points of origin for debris avalanches and debris flows.

Step-like benches or small scarps: Scarps, benches, troughs, or narrow ridges occur along the contour with no obvious geologic explanation (e.g., these features may look like some ancient culture built a road there—distinguish from possible historical or First Nations trails, which are typically much narrower). Terracettes are a series of very long and narrow terraces, often discontinuous, that run parallel to the contour of a slope and often occur in groups; usually produced by very local, surficial slumping.

Displaced stream channels: Channels laterally displaced at the base of a landslide; usually pushed to the opposite side of the valley or fan. Also, streams flowing haphazardly across (or discontinuous channels in) old landslide deposits or lumpy, open slopes.

Ridged marine deposits: Large slide deposits immediately offshore from the ocean visible from above or on aerial photos; can also occur around larger interior lakes.

4. SOIL FEATURES

Soil and rocks piled on the upslope side of trees: Extra woody debris, thick forest floor, or soil debris accumulating on the uphill side of trees; stump height differences seem exaggerated up and downslope; hollows may appear under roots on downhill side.

Mixed or buried soil profiles: Mixed soil profiles in soil pits provide strong evidence of soil movement. Check a few more locations; isolated occurrences may be attributed to windthrow or animal burrows.

Poorly developed soils relative to other comparable slopes: Soils that have weaker or no soil development when compared to neighbouring, more stable areas (e.g., Regosols in an area that normally has Podzols indicates that the soil parent material was recently exposed); by itself, a strong indicator of slope instability.

Shallow, wet, organic soils on slopes > 40%: Very thick forest floors (> 25 cm) with seepage, or organic soils occurring on steep slopes (> 40%), indicate that enough moisture is present to cause potential instability problems. The surface soil and forest floor may actually be moving downslope; finer-textured or dense soils often occur at depth.

Poorly drained medium- to fine-textured materials > 3 m deep: Cohesive materials (medium to fine textured) can accumulate large amounts of water and become unstable; prone to creep, slump, and earthflow. Creep is an imperceptibly slow, more or less continuous downward and outward movement of slope-forming soil or rock. Slump is the downward slipping of a mass of rock or unconsolidated material of any size, moving as a unit or as several subsidiary units, usually with backward rotation. Earthflow is a slow flow of earth saturated with water.

5. BEDROCK / ROCKSLIDE FEATURES

Talus or scattered boulders at base of slope: Talus is a collection of fragmental material on or below a steep slope. The angle of repose (maximum stable slope angle) for talus usually averages 35–40° (70–80%).

Rock faces with freshly exposed rock: Indicated by fresh rock accumulations at the base of the slope or by fresh cliff faces with little or no moss or lichen growth; steep rock cliffs represent potential sites for rockfalls and rock slides. Inspect cliffs and steep bedrock outcrops for evidence of fresh or

recent movement. Look below the outcrop for large boulders or blocks of rock resting on overburden or talus rock.

Steeply dipping bedrock discontinuities that parallel the slope: Bedrock occurring in layers that are steeply inclined out of the hill slope; are often prone to topple failure or slippage. Dip is a geological term for the angle that a planar feature (i.e., bedding plane) makes with the imaginary horizontal plane.

Bedrock joint or fracture surface intersections that dip steeply out of the slope: Joints or fractures dipping out of the slope, or parallel to the slope, that can result in failure from gravitational forces, frost, or disturbance; allow water to concentrate, which can cause pressure-induced failure, or result in springs developing at remote sites on the slope. A fracture is any break or discontinuity in a rock. Fractures include cracks, joints, and faults. A fault is a fracture in rock along which movement has occurred.

6. ROAD FEATURES

Bulges in road: Deformation of road surface attributed to slope movements; may appear as "speed bumps" or drops in the road surface.

7. GULLY FEATURES

Poorly drained or gullied fine-textured materials < 3 m deep on slopes > 50% : Fine-textured materials (clay in texture) with high moisture content on steep slopes; prone to creep, slump, and earthflow; these shallow materials can become quickly saturated and unstable.

Poorly drained or gullied coarse-textured materials on slopes > 50%: Non-cohesive materials (coarse textures low in clay; cannot roll a "worm" when hand texturing) on steep slopes, prone to debris avalanches and debris flows, even in the absence of excess moisture.

Recently scoured gullies: Gully floor scoured clean of sediment and woody debris; U-shaped channel cross-section; scouring typically occurs on slopes of more than 18%; by itself, a strong indicator for slope instability.

Vegetation in gully much younger than the adjacent forest: Trim lines in the surrounding mature vegetation with younger vegetation and trees along the floor and lower sides of the channel. A trim line is a line along a gully, stream, or river channel where erosion is readily apparent by the removal of larger, older vegetation. Very fluid debris can run through trees; look for a lack of moss on the ground, or fresh soil and mud on the lower parts of tree trunks.

Exposed soil on gully sides: A sidewall scar that may have a deposit below, or a channel empty of sediment and debris below the scar.

Debris piles at the mouths of gullies: Piles, lobes, and levees (Figure 29) of debris are composed of large woody debris and mixed deposits in the deposition zone; indicative of past debris flows upslope. A levee is a bank of sediment, bordering one or both sides of a gully.

Poorly developed soils on gully sides relative to adjacent slopes: Young, shallow soils (a result of repeated gully wall failure over time), compared with adjacent slopes, where gullies develop in deep tills or glaciofluvial materials; also found on floors of active gullies.

8. OTHER INDICATORS

If other indicators of instability are observed in the field, but not listed in the above sections, record them here. Further indicators of instability include the following.

Piping: A form of subsurface erosion in which holes from a few centimetres to a metre in diameter develop (most commonly in glaciolacustrine stream banks, gullies, or draws near edge of terraces); is associated with temporary saturation and subsurface erosion, or high salt content in soils; in some cases, initiated by animal burrows; horizontal erosion or vertical sinkholes are often visible in road cuts and scarps in silty, fine-textured, or sandy noncohesive soils; may look like mine fields.

Extensive seeps / springs: Two or more seeps, or springs, per 100 m occurring across the contour above toe-slope locations; often indicate moisture levels that can influence instability.

Heavily faulted or folded / fractured rock formations: Rock that is not solid, as observed in burrow pits or on road cutbanks; contains fractures along which movement has occurred.

Extensive or retrogressing cutbank failures (Interior only): Roads, skid roads, or landings with continuous areas of failing cutbanks, or failures that keep moving upslope every year, often indicate serious slope instability at an Interior site; may be due to excessive soil moisture; can cause drainage diversions, leading to larger landslides.

Tension cracks in middle of road: Cracks occurring mid-road or along the inner track (rather than sidecast); indicate subsoil failure.

Clay-rich glaciolacustrines < 3 m deep on slopes > 40%: Fine-textured materials with high moisture content on steep slopes; may be prone to creep.

slump, and earthflows; shallow materials can become quickly saturated and unstable.

Mottled or gleyed soils on slopes: Reddish mottles in a bluish grey matrix, if prominent, indicate a high water table; groundwater is a primary factor in slope failures.

> ***Note:*** *If slope instability indicators are present, a terrain stability field assessment must be carried out to the satisfaction of the district manager.*

47. COMMENTS / DIAGRAM
Provide further clarification, where required, on information related to ITEM 46, or use this area for a diagram (profile of soil pit, sketch map indicating location or nature of instability features, etc.).

3.2.2 Silviculture Prescription Stratum Card (FS 39B)

When the information from the field assessment and the detailed sample plots have confirmed your strata, complete a stratum card (FS 39B) for the area. This helps to summarize prescription issues for a proposed Standards Unit and ensures that you consider as many prescription factors as possible while still in the field. Use common sense when completing this card: record field observations relevant to the SP (which must recognize local resource value concerns). Ignore sections that are not relevant to the SP, or any factors already assessed (e.g., stream or gully assessment). For instance, do not write up information that is irrelevant to the local resource issues or that is already available from the office review, unless you need to confirm it. Observe and be watchful for clues relating to all factors mentioned on the stratum card (e.g., similar, older cutblock areas nearby can provide useful insights). Also, do not hesitate to collect any additional data items, not included on this card, that may be necessary to support the prescription.

REFERENCE DATA

1. LICENCE NO.
Record the tenure number (FL A01234, TFL018, etc.).

2. LICENSEE
Record the person or company name of the tenure holder, not the contractor name. If Small Business Forest Enterprise Program, record as such.

3. CUTTING PERMIT (C.P.)
If applicable, and known, record the cutting permit number.

4. BLOCK
Record the cutblock number of the cutting permit for this SP. Use this data field to record the Ministry of Forests opening number for areas that were created by means other than harvesting.

5. STRATUM AREA (ha)
Record the area, in hectares, of the stratum.

6. STRATUM
Record the stratum (e.g., A, B, C) to which the field data is applicable.

7. SURVEYOR(S)
Record the name(s) (not initials) of the person(s) who collected and recorded the SP field data. Record the field assessment date.

8. PLOT NUMBERS IN STRATUM
Indicate the appropriate plot numbers from Plot Card FS 39A that relate to this stratum.

SITE DATA

The silviculture prescription must describe the biogeoclimatic ecosystem classification and any critical site conditions that would affect the timing, or manner, of operations.

9. BGC ZONE, SUBZONE, VARIANT
Indicate the biogeoclimatic zone, subzone, and variant(s) existing in the stratum. Record as codes, using those presented in the regional ecological field guide. For example:

BIOGEOCLIMATIC ZONE, SUBZONE, AND VARIANT

ZONE	SUBZONE	VARIANT
ESSF	dc	1
IDF	xh	2

Record transitions between subzones or variants, if they are present.

Phase: If applicable, record the recognized "phase" descriptor provided in the regional ecological field guide (e.g., IDF xh2a).

Site Series: Use the regional ecological field guide to determine and record the numeric site series (e.g., 01, 02) for the area.

If the stratum is compound, indicate the percent composition of each site series (e.g., 03 = 60%, 04 = 30%, 02 = 10%). Then, describe in ITEM 12 how these are positioned in the landscape so that they can be recognized and managed.

10. ELEVATION (m)
Record the minimum and maximum elevation of the map stratum in metres based on representative plot and transect observations. Measure elevation with an altimeter, which is set daily to a known elevation benchmark.

11. SLOPE (%)
Record the minimum and maximum slope gradients and the predominant slope gradient in percent based on representative plot and transect observations. Measure slope using a clinometer or Abney level.

12. CRITERIA-DEFINING STRATUM
Outline the criteria used to delineate and define the stratum being described. This may be the biogeoclimatic site series, a forest health factor, soil sensitivity, or stand management objectives, or some combination of criteria.

RIPARIAN / WATERSHED VALUES

Field check all water bodies identified during the office preparation and mapping phase. In the silviculture prescription a riparian class (if applicable) must be provided for each stream, lake, and wetland in the prescription area, including any not identified during the office preparation and mapping phase. The known lake classification must also be provided for any lake in, or adjacent to, the prescription area. Provide a map to illustrate all streams and wetlands in, or adjacent to, the area, as well as the associated riparian class. Definitions follow throughout this section, for all data collection entries located in the riparian section of the stratum card.

- ***Stream*** – Any reach, flowing on a perennial or seasonal basis, with a continuous channel bed (whether or not the bed or banks of the reach are locally obscured by overhanging or bridging vegetation or soil mats) that is either scoured by water or contains observable deposits of mineral alluvium.

  Ephemeral streams have defined channels, but flow for only part of the year, usually in winter and spring in Coastal drainages, and in spring and early summer in Interior ones. Ephemeral streams of less than 20% gradient may be fish streams.

  Six riparian classes (S1 to S6) of streams are based on the presence of fish, occurrence in a community watershed, and the average channel width.

- ***Stream channel width*** – The horizontal distance between the tops of the stream banks as determined by the normal high water mark on opposite sides of the stream, measured at right angles to the general orientation of the banks.

- ***Reach*** – A length of a watercourse having similar channel morphology, channel dimension, and gradient.

- ***Fish stream*** – Any stream reach frequented by any of the following species: anadromous salmonids, rainbow trout, cutthroat trout, brown trout, bull trout, Dolly Varden char, lake trout, brook trout, Kokanee, largemouth bass, smallmouth bass, mountain whitefish, lake whitefish, arctic grayling, burbot, white sturgeon, black crappie, yellow perch, walleye, northern pike, or identified threatened, endangered, or regionally important fish determined under of the provisions in the *Operational Planning Regulation*.

  All reaches of streams that have a slope gradient of less than 20% must be identified and mapped as fish streams, unless a fish inventory, carried out in accordance to the *Fish-stream Identification Guidebook*, demonstrates that none of the fish species listed above is present. (If further guidance is required, contact the local Ministry of Environment representative.) This 20% gradient rule for "default" fish-bearing status does not apply when the following **three** conditions occur:
  - the stream is located upstream of a known barrier to fish passage, identified on a fish and fish habitat inventory map;
  - all reaches upstream of the barrier are simultaneously dry at any time of the year; and
  - no perennial fish habitats exist upstream of the barrier.

- ***Riparian Reserve Zone (RRZ)*** – An area of specified width located adjacent to a stream, wetland, or lake within a Riparian Management Area, as determined by Part 8 of the *Operational Planning Regulation* (see "Note" below). Harvesting is not permitted except in special circumstances that require joint approval by the district manager and a designated BC Environment official.

- ***Riparian Management Zone (RMZ)*** – An area of specified width located adjacent to any riparian reserve zone, or if there is no riparian reserve zone, located adjacent to a stream, wetland, or lake within a Riparian Management Area as determined by Part 8 of the *Operational Planning Regulation* (see "Note" below). Constraints to forest practices apply.

  Note: *Part 8 of the* Operational Planning Regulation *provides for minimum widths only. It is up to the surveyor and prescriber to ensure that the widths chosen are adequate to meet the riparian management*

objectives. If the minimum widths specified in the Operational Planning Regulation *are not of adequate size to manage for riparian objectives, recommend a wider zone. For example, larger reserve or management zones may be necessary in areas prone to high windthrow hazard.*

13. STREAMS

If not already identified and classed by a stream classification assessment, provide an identifier (distinct name, number, etc.: standard water body identifiers and watershed codes are preferred) for each stream or reach in the stratum.

- Describe the approximate length of the reach and determine the average channel width in metres.
- Provide the average gradient along the length of each reach.
- Is the stream frequented by fish? Record "Y" for yes, "N" for no, and "?" for unknown.
- These descriptors will help determine the riparian class (see Table 7) for the stream or reach.
- When assigning the stream class to a reach as S1, S2, S3, S4, S5, or S6, specify whether the class was based on an approved fish inventory or on gradient criteria alone.
- Using the riparian classifications in Table 7, or field cards FS 900A (Coast) or FS 900B (Interior), determine the applicable Riparian Reserve and Riparian Management zones for each stream or reach identified.

The *Riparian Management Area Guidebook* and the *Fish-stream Identification Guidebook* will provide further details on this topic.

14. OTHER WATER BODIES / NUMBER AND TYPE OF WATER BODY

Check which type(s) of water body exist in the stratum and indicate the number (by type) on the adjacent line. Refer to the definitions for water bodies below.

- ***Lake***: A naturally occurring, static body of fresh water (> 2 m deep and > 0.25 ha in size), or a licenced reservoir.

The four riparian classes (L1–L4) for lakes (Figure 30) are based on lake size and the biogeoclimatic unit in which they occur (see the *Riparian Management Area Guidebook* for definitions).

TABLE 7 *Specified riparian zone widths for stream riparian classes (B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks 1995)*

Identify if:	Riparian class	Average stream channel width (m)	Riparian zone width (m)	
			Reserve Zone	Management Zone
Fish Stream	S1: large rivers[a]	≥ 100	0	100
	S1: except large rivers	> 20	50	20
or within Community Watershed	S2	> 5 ≤ 20	30	20
	S3	1.5 ≤ 5	20	20
	S4	<1.5	0	30
Neither of the above	S5	> 3	0	30
	S6	≤ 3	0	20

a A stream greater than 1 km long, greater than 100 m wide, and with an active floodplain greater than 100 m wide.

- *Wetland*: A swamp, marsh, or other similar area supporting natural vegetation that is distinct from the adjacent upland areas; must have both hydrophytic vegetation and subhydric to hydric soils.

  The five riparian classes (W1–W5) for wetlands are based on whether the wetland is simple or complex (see the *Riparian Management Area Guidebook* for definitions), wetland size, and the biogeoclimatic unit in which they occur (Figure 31).

- *Spring*: An area where the water table is higher than the surface on a slope microsite, creating a running water source at that location (may return subsurface downslope); can be ephemeral or perennial; can also occur on flat ground (artesian spring). There is no defined, continuous stream channel bed. Riparian classes do not apply.

- *Seep*: An area where the water table is at the surface, creating a water-saturated soil condition evident by hydrophytic vegetation, thick forest floors or organic soils, standing surface water, or seeping conditions. There is no defined, continuous channel bed. Riparian classes do not apply.

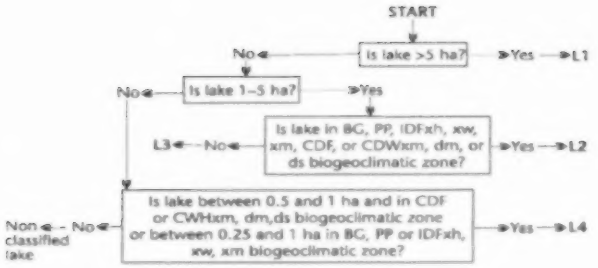


FIGURE 30 *Key to lake riparian classification.*

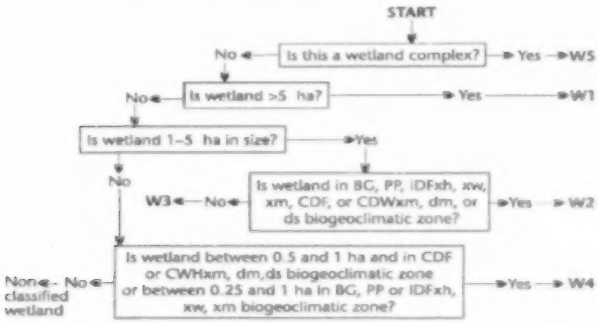


FIGURE 31 *Key to wetland riparian classification.*

- *Off-channel / Intermittent*: Areas that provide aquatic environments permanently or seasonally; include ephemeral (intermittent) tributaries, side channels, or flood channels of the main stream, swamps (flooded woodland), sloughs (marsh or mixed woodland), valley-wall base ponds, lakeshore areas, sites dammed by beavers, and other flooded areas within the floodplain apart from the main stream channel. Appropriate riparian classes pertaining to streams, lakes, and wetlands can be assigned, if necessary.
  - *Fisheries-sensitive Zones* (FSZs) – Often called "off-channel habitats" because these drainage features do not meet the definition of a stream. These sites are usually floodplain features that occur in close association with stream channels and lakes (e.g., flooded depressions, ponds, or swamps) and are occupied by fish at least some time during the year. Many features qualify as FSZs. They may be

small (< 0.1 ha), ephemeral, or intermittent drainage features that are especially difficult to detect when dry. They may also include major floodplain features that cannot be classified as streams because of channel bed discontinuities or insufficient presence of either scour by water or deposits of mineral alluvium (e.g., flooded woodland swamps, sloughs of marsh or mixed woodland, valley-wall base ponds, and small watercourses). Fisheries-sensitive Zones are protected through appropriate practices outlined in the *Timber Harvesting Practices Regulation* (*sections 10, 12, and 23*); it is helpful to include these on SP maps and flag them in the field before harvesting.

COMMENTS FOR ITEMS 13 AND 14

For any water body identified in the stratum, describe and, if necessary, assign an appropriate Riparian Reserve and Riparian Management Zone width. If the riparian vegetation is distinct from the surrounding forest, describe its structure, species composition, and other defining characteristics. Vegetative cover in the IDF, ICH, PP, BG, and CDF biogeoclimatic zones can be especially important in maintaining water temperatures tolerable to fish.

Include any **special management considerations** (i.e., any proposed forest practices within a reserve or management zone, any wildlife habitat areas, or any proposed group reserves, including wildlife trees) for a given Riparian Management Area. Where harvesting is proposed within a riparian or lakeshore management area, the prescription must also include strategies to protect stream banks and to maintain shade over known, temperature-sensitive streams.

- ***Bank/Streambed Materials*** – Describe bank configuration by noting height and average gradient in percent, whether the bank appears stable or shows signs of recent erosion, and whether windthrow is evident. This information is not mandatory, but may be useful when assessing channel and bank stability. It will also help when identifying appropriate management options.

  Record the predominant substrate type in the streambed. Substrate type can be described by any, or a combination, of the following: organics, fines, gravels, cobbles, stones, or bedrock.

  Record the frequency, location, and size of log jams, anchored woody debris, overhanging banks, or vegetative cover. The stability of some stream channels and stream banks depends on the continued presence of woody debris and live tree root networks in the channel and bank.

Do any of the water bodies identified in the stratum flow directly into, or connect with, fish-bearing water bodies? If so, identify which water bodies these are, and record the distance to the fish-bearing water body. Determine if a riparian class is applicable using the *Riparian Management Area Guidebook*.

If fish or fish habitat are present, record and describe the fish species and the water body concerned. If Marine- or Fisheries-sensitive zones are present, describe them.

> ***Note**: Important references for completing this section include the* Riparian Management Area Guidebook *and* Fish-stream Identification Guidebook.

15. GULLIES (OPTIONAL FOR INTERIOR SITES)

For Coastal locations, if gullies greater than 3 m deep have not already undergone an assessment, then completing the Coast gully table on the stratum card will provide some necessary information to evaluate any hazards associated with the gully. Refer to the *Gully Assessment Procedure Guidebook* for more detailed coverage.

For Interior locations, gully systems >5 m deep should be typed out and addessed separately for soil disturbance hazard assessment during data collection.

If harvesting is proposed within a gully, the prescription must describe management strategies that are consistent with the completed gully assessment. Record any special management considerations that may be applicable in the comment section above ITEM 15 (e.g., if proposed, falling and yarding away from gullies; protecting gully banks; minimizing damage to the understorey; addressing sediment and debris transport potential and debris management).

- ***Gully*** – An area, whether containing a stream or not, where the overall gradient is at least 25%, and a reach of that gully (> 100 m long) has:
  - a side wall greater than 3 m,
  - a side slope greater than 40–50%, and
  - a channel gradient greater than 20%.

Riparian classes are not assigned to gullies; however, a detailed assessment, following procedures set out in the *Gully Assessment Procedure Guidebook*, will help to rate any hazards within the gully that may be affected by management activities, and to identify hazards to downslope resources.

Gully No.: Identify each gully system by a separate identity code. If the gully has more than one segment, identify each one separately: separate descriptions are required for each gully segment. A map recording each gully number would be useful.

Channel: Suggested information to collect about gully channels includes:

% Gradient: Indicate the overall gradient of the channel (or segment) as a percent slope over a minimum distance of 40 m.

Width (m): The full width, in metres, of the gully, top bank to top bank.

Depth (m): The full depth, in metres, of the gully, from a horizontal line spanning the gully from bank tops to the bottom or floor.

Length (m): The length of the gully segment, in metres.

Surficial Materials: Assess and record the materials in the gully channel and/or sidewalls as either rock (R), colluvial materials (C), morainal and fluvial materials (M or F), or marine and lacustrine materials (W or L). Fluvial materials include glaciofluvial deposits. Lacustrine materials include glaciolacustrine deposits. Surficial materials differ in their slope failure potential.

Debris Torrent: Indicate any evidence of a debris flow (e.g., levees, plugs/lobes, sidewall scar) or a landslide within the gully. Qualify whether it is recent or older. Past debris-flow activity is a good indicator that the potential exists for future debris flows.

Gully Wall: It is important to record % slope and height of gully walls. If height varies, record information for the highest side.

% Slope: Measure and record the slope percent from the base of the gully to the top. Do not confuse with the gully percent gradient. In gullies consisting of a steeper inner gully located within an outer gully, measure the inner gully slope percent.

Height (m): Measure and record height from the bottom of the gully to the top at the slope break in the same location where the gully slope angle is measured.

16. WATERSHED VALUES

Consider and discuss how the prescription for the stratum may influence surface erosion, natural drainage patterns, and the water table. Any prescribed treatments should minimize the potential for alteration of natural drainage patterns and surface runoff. Consider whether your planned access

route(s) will channel water. Note any actions needed to protect watercourses and water quality, such as harvesting modifications, culvert location and size, and riparian reserves. This is particularly important if the stratum falls within a community watershed, or has licenced or unlicenced downstream water users. Do any of the water bodies identified **not** connect directly with a sensitive watercourse?

Water quality is influenced by erosion, landslides, avalanches, soil and geologic parent material, vegetation, climate, season, and human activities. High water quality is promoted primarily by reducing suspended sediments. Suspended sediments can be minimized in riparian areas by special management and by advanced planning in the location and construction of access routes.

Sedimentation (of eroded and transported fines and coarser materials) is accelerated by the following forest activities: the construction, use, and maintenance of access routes (including bladed trails); harvesting practices including felling, skidding, decking, loading, and hauling; livestock grazing; and recreation activities, such as operating all-terrain vehicles and camping. Practices less likely to cause sedimentation, but that may in localized, sensitive areas, include skidding, site preparation, and felling.

RESERVES

Reserves can take on numerous forms: they can be single trees (e.g., green trees or "safe" wildlife trees), forested patches (e.g., for wildlife, seed, unstable ground, hydrologic purposes), or areas surrounding an important feature (e.g., lakes, streams, scenic). Reserves are maintained for at least one rotation. If trees are to be retained for short periods of time (e.g., seed or shelterwood trees), they should not to be recorded as reserves. Reserves will not normally be subject to harvest entries, except in special circumstances. These are authorized by joint approval of the district manager and a designated environment official. For example, harvest entries may be required and planned to meet a management objective such as forest health or a specific type of riparian class.

Many reasons exist for including any type of reserve within the SP area. Reserves can be established to provide:

- cover and sustenance for wildlife and fish;
- recruitment of coarse woody debris;
- nesting sites for birds;
- protection (e.g., rare plant associations, important wildlife habitat, archeological findings, historical values, cultural values, sensitive sites, wind-prone areas, scenic values, areas of historical livestock use);
- fire breaks (for fuel management); or
- riparian values.

The above constitute only a few examples of reserves.

17. RESERVES

Indicate whether or not reserves will be applicable to the stratum (i.e., within or adjoining). To be classed as a reserve, the area must be designated for long-term retention (no harvest entry for one rotation). If applicable, describe the type of reserve and explain the need for it. For example:

- ***Wildlife tree reserves (WTRs)*** – should include a description of the features and values they contain, as well as the need for them. Indicate approximate numbers, species, and distribution (see discussion of WTRs in the *Landscape Unit Planning Guide*).
- ***Single wildlife trees*** – should be described by their dbh (cm), height (m), number per stratum, distribution (group, uniform, variable), function or purpose, and as dead, live healthy, or live unhealthy. Further comments can relate to present use by wildlife, proximity to riparian areas, hardwood patches, rock outcrops, etc.
- ***Timber management reserves*** – might describe the wood quality and piece size for trees left for an extended rotation.
- ***Riparian reserves*** – must meet the minimum criteria outlined in the *Riparian Management Area Guidebook*.

HAZARD / INSTABILITY

18. SOIL HAZARD / INSTABILITY SUMMARY

The SP must address issues of soil compaction, surface soil erosion, and soil displacement wherever ground-based operations are planned. Provide a summary of the compaction, soil displacement, and surface soil erosion characteristics of the stratum by providing the range for all plots located in that stratum. Assessing forest floor displacement hazard is a recommended option in some interpretive guides. In addition, for the Interior, providing the mass wasting hazard rating is an option that should be considered. If a range of ratings or points occurs for any one factor, provide the range.

Referring to all plot cards and ancillary notes completed for the stratum, indicate by a Yes or No whether slope instability indicators are present.

> ***Note:*** *If slope instability indicators are present, a terrain stability field assessment must be carried out to the satisfaction of the district manager.*

19. FIRE HAZARD ABATEMENT

If a fire hazard (from concentrations of slash) is expected to increase after harvesting, discuss the actions necessary and time frame required to abate the hazard.

Consider the nature of the existing fuel complex (e.g., windthrow, snags, woody debris) and the fuel loading, along with nearby sources of ignition (e.g., nearby campsites, major access routes, lightning incidence). Predict how harvesting will affect the fire hazard. Management options that can affect fuel management include: modifying the shape, size, and orientation of a cutblock; mechanically preparing the site to break up or redistribute slash; leaving fire breaks; and prescribed burning.

Hazard abatement activities must be consistent with higher-level plans and conducted according to a burning plan or smoke management plan, but it is unnecessary to outline specific activities in an SP; to help with the overall prescription process, the surveyor just needs to identify apparent fire hazard abatement concerns. The *Fire Management Guidebook* provides assistance in quantifying fire hazard and describing hazard abatement methods.

20. WINDTHROW HAZARD

Note whether wind damage is evident in, or adjacent to, the stratum by the presence of any of the following:

- ***Stem break*** – The bole of the tree snaps well above the ground; occurs more frequently during strong gales and hurricane-force winds, or heavy snow loading with strong winds, particularly on sites where good root anchorage occurs, and in trees that have been weakened by disease.
- ***Stock break*** – The bole snaps at ground level.
- ***Root break*** – The tree is uprooted by pivoting on broken roots directly beneath the bole; typically occurs in trees with small root systems, trees with root rot, or trees growing in sandy or wet soils that have a low shear strength.
- ***Tree throw*** – The tree is uprooted by pivoting on the outer edge of a massive plate comprised of soil and roots; occurs more commonly in trees with a shallow, plate-like root system on very wet sites, or on shallow soils.

When assessing the windthrow hazard of a specific site, consider the following factors:

- aspect
- topographic position (macro- and mesoscale)
- elevation
- percent slope
- bedrock type/physiography
- soil classification (e.g., texture)
- humus depth
- soil depth
- rooting depth

- soil drainage
- presence of root or butt rot
- cutblock boundary orientation and shape
- size of cutblock
- tree species
- dbh and density
- stand height and tree age
- prevailing winds
- historical storm patterns

The importance of these factors will depend on the local conditions.

Refer to the *Windthrow Handbook for British Columbia Forests* (Stathers et al. 1994) for a more complete discussion on windthrow.

SILVICULTURAL SYSTEMS / OBJECTIVES

21. SILVICULTURAL SYSTEMS / MANAGEMENT OBJECTIVES
State the management objectives and determine the range of silvicultural systems that are ecologically suited to the site. Specific stratum objectives must be compatible with the resource management objectives stated in higher-level plans and forest development plans.

Surveyors should demonstrate that they understand the planned management objectives for the area. Consider the general site description (BEC site series, soils, vegetation, etc.), as well as the concerns for the other potential limiting factors (climate, brush, fire, pests, etc.). All other resource values must be considered.

Evaluate the silvicultural system for its ability to maintain site productivity and promote forest health. Also consider the system's silvicultural feasibility (future stand composition and structure, residual basal area) and its harvest feasibility (including protection of reserves and designated understorey).

The choice of a silvicultural system must also involve the consideration of social and economic factors, along with necessary Workers' Compensation Board (WCB) regulations.

An SP must describe the proposed silvicultural system. For all silvicultural systems, the desired post-harvest stand structure and site condition must be stated in the prescription, as well as the species and function of trees that will be left standing.

The *Silvicultural Systems Guidebook* provides guidance and instruction on selecting an appropriate silvicultural system.

HARVESTING

22. HARVESTING

Specifying type of harvesting system is not required in the Silviculture Prescription. However, the SP must describe any **critical site factors** that may affect the timing of operations and the manner in which timing will be affected. Timing may be described in terms of seasonal site conditions (e.g., the desired/appropriate soil moisture, frost, or snow condition during which operations should occur). While still in the field, it is useful to indicate the most appropriate harvesting system(s) for the stratum, and to elaborate on how this system will help to achieve the desired post-harvest conditions.

When proposing a harvesting system, consider the soil disturbance hazards, the identified resource values and limiting factors, and the future tree species and stand structure. Whenever possible, indicate more than one harvesting system to provide flexibility and to possibly reduce the need for any future amendment(s) to the SP.

For ground skidding the preferred strategy might be designated trails at a spacing compatible with soil conservation objectives (e.g., 30 m followed by some rehabilitation to keep final disturbance below 10% on a moderate disturbance hazard site). Alternative strategies might include dispersed skidding when, and if, soil conditions become favourable. This combined strategy usually guarantees success in terms of maximizing the operating season while still ensuring soil conservation. Judicious use of feller-bunchers (e.g., turning only on trails) can also be accommodated (see Curran 1999).

For another example, timber in a narrow, wet depression is surrounded by dry ground suitable for summer skidding. The harvesting options in this case could include the following.

- Log during winter when the soils are frozen or covered with a protective snowpack.
- Directionally fall and hoe forward the timber to where it can be ground skidded outside of the wet depression.
- Use long-line extraction from outside of the wet depression.

Record any OPERATIONAL CONSTRAINTS for different harvesting techniques. Harvesting concerns might involve: steepness of the terrain; potential barriers; limitations to landing size or location and machinery type; WCB requirements; season of operations; and skid trail patterning.

On most blocks, the harvesting constraints will be determined by the highest soil hazard rating. Refer to the soil hazard/instability summary (ITEM 18) for plots located within the stratum.

Although this section is not intended to be the logging plan, discuss whether the PROPOSED ROUTES (roads, landings, excavated/bladed trails, etc.) pose any engineering concerns. These concerns would include slope instability features, cuts and fills, site disturbance, machine limitations, and culverts. Note any problem locations, such as rocky areas, riparian areas, gullied sections, etc.

FOREST HEALTH

23. FOREST HEALTH FACTOR INCIDENCE

In the table provided, list any forest health factors (biotic and abiotic) noted in, or adjacent to, the stratum. Indicate the tree species affected (i.e., host trees).

Estimate, from a walk-through, the percent incidence of the pest in the overstorey layer by recording the percentage of host trees affected and then the percentage of total trees affected, *or* the percentage of the total area affected, depending on the type of agent. Refer to any previous survey information (e.g., root rot survey). Indicate the magnitude of risks as low (L), moderate (M), high (H), or very high (VH). Risk refers to the probability and expected severity of tree or stand damage. Some factors contributing to risk include availability of host species, shape and size of cutblock or opening, geographic location, resilience of managed crop species, or amount of light.

Identify any forest health factor estimated to be within the range of threshold values (indicated in the specific forest health factor guidebooks or handbooks) and indicate the appropriate pest survey, if required. Specific pest surveys should be carried out only when necessary (e.g., as outlined in the *Forest Practices Code of British Columbia Act*).

> ***Note**: Use the following Forest Practices Code guidebooks and any regional guidelines to determine the incidence level and management strategies for various pests*: Forest Health Surveys, Dwarf Mistletoe Management, Root Disease Management, Defoliator Management, Pine Stem Rust, Management of Terminal Weevils, and Bark Beetle Management. *The* Field Guide to Pests of Managed Forests in British Columbia, *or the* Field Guide to Forest Damage in British Columbia, *will help to identify the pests.*

Comments / special considerations: Indicate whether the forest health factor is present in, or adjacent to, the stratum. If a health factor is identified adjacent to the stratum, record its approximate distance from the proposed cutblock. Some forest health factors (e.g., mountain pine beetle) may pose a risk even if they are located in the general vicinity of the stratum (i.e., area

under a forest development plan). Describe the incidence as continuous or intermittent in nature.

Clarify the distribution of the forest health factors that are currently present. Record the tree layers affected, the number of dead trees, and the observed effect on the host trees.

Assess any forest health factors or hazards that might be expected to occur before the harvest of the next crop (see the *Forest Health Surveys Guidebook*).

> ***Note**: Always indicate if no significant forest health problems are found during the walk-through, especially for ecosystems designated as a high hazard for certain pests. Refer to the Forest Health Charts in Appendix 6 of the* Establishment to Free Growing Guidebook, *or tables available in regional ecological field guides.*

SILVICULTURE

24. LIMITING FACTORS

Assess factors for the stratum that could limit crop tree establishment, survival, and growth. Some regional ecological field guides describe common growth-limiting factors for the various BEC subzone/variants (e.g., Braumandl and Curran 1992). These are also the subjects of the SYTEPREP decision aid (Curran and Johnston 1991).These may include one or several of the following.

SOILS

Cold soils: Optimum root activity occurs at temperatures close to 20°C. However, northerly latitudes and high-elevation sites will have soils that stay below 10°C well into the growing season. These cold soils will reduce root growth and, therefore, the seedling's vigour and subsequent growth.

Cool, shaded microsites in cold subzones should be avoided. Burned microsites may increase soil temperatures by reducing the depth of organic matter and blackening the surface. Mounding will greatly improve the soil temperature regime by elevating and exposing mineral soil.

Shallow soils: These will hold much less water than deeper soils and therefore tend to dry out. They also limit rooting volume and can be prone to nutrient deficiencies. Shallow soils can be difficult to plant.

Deep organic layers: Organic matter is a poor thermal conductor, and organic layers will keep soils colder than if the mineral soil is exposed. However, decomposed organic humus on some wet and warm, highly

productive sites may be the best rooting medium because of the excess moisture below.

Organic matter often contains the bulk of soil nutrients, helps retain moisture and soil porosity, and protects the underlying soil from structural damage and erosion. Surface organic layers also have a high water-holding capacity.

Soil temperature and moisture levels beneath deep forest floors fluctuate less throughout the growing season. This effect may be undesirable for cold climates and aspects because seedling root growth may be inhibited by low soil temperatures during the growing season. However, for warm climates and aspects, the presence of a deep forest floor may help to conserve soil moisture. Well-decomposed organic layers can be an acceptable planting medium, especially on freely drained mounds on very wet sites.

High % coarse fragments: Coarse fragments reduce the available water storage capacity of a soil. They can also limit rooting volume. Generally, soil nutrient capital decreases as coarse fragment content increases. Stoney soils can be difficult to plant.

Wet soils: Sites with restricted drainage and high water tables can limit tree growth. Oxygen uptake by roots is impaired when water occupies soil air spaces. Saturated soil conditions can also result in lower soil temperatures. Seasonally wet soils, as evidenced by mottling, indicate unacceptable seedling microsites.

If naturally occurring, well-drained hummocks are unavailable, site preparation is likely a consideration. Moisture-tolerant species and some forms of site preparation (e.g., mounding) can help alleviate this problem. Management prescriptions should maintain or improve soil drainage and aeration.

Nutrient-deficient soils: Low nutrient levels are unlikely to affect seedling establishment, although they can influence growth over the long term. Calcereous soils (high pH soils, often derived from limestone) are considered to cause nutrient deficiencies in trees if the high pH layer is close to the surface (<30 cm.) Nutrient-deficient trees can also become vulnerable to many other factors (e.g., pests). Nutrient requirements vary by tree species.

Consider where most of the available nutrients and appropriate rooting media are located in the soil profile. Many soils in British Columbia are characterized by a concentration of the soil nutrient capital in the upper soil horizons. Mixing humus materials with the surface mineral horizons may improve the nutrient status for the seedling (use caution where unfavourable substrates may be present).

HEALTH

Pests: Insects or diseases can destroy, damage, or reduce growth rates of the new forest crop. For this assessment, examples from older nearby cutblocks can be used. Examples include: Rhizina root rot (primarily in wet areas of the Vancouver, Prince Rupert, and Nelson forest regions, where the site will be slashburned), stem rusts, dwarf mistletoes, plantation weevil, and black army cutworm. Pests often attack trees already stressed by other factors.

Refer to any forest health factor previously identified in the forest health section (ITEM 23).

Root disease: The presence of root disease will limit the choice of crop tree species for the site and have management implications for all phases of the silvicultural system. Partial-cut harvesting, and commercial thinning, spacing, and brushing treatments must all be cautiously reviewed before being prescribed in the SP.

When evaluating a prescription, all high-hazard and high-risk biogeoclimatic subzones (see appendices in the *Root Disease Management Guidebook*) **shall be considered as infected** at a level exceeding the maximum treatment threshold **unless otherwise stated in the prescription**. The prescription must address these infection levels, even if root disease is absent from the stratum, or present at a lower incidence level. The only exception is when the prescription explicitly indicates the absence of the root disease from the opening or cutblock.

Wildlife damage: Wildlife can chew or cut roots, debark main stems or branches, or remove foliage and buds. Tree wounds caused by wildlife can allow disease organisms to enter the tree. Reduced growth rates, lost volume, deformity, and mortality can result.

Most wildlife problems related to tree establishment occur in high-use areas, such as winter ranges, small blocks, and timber edges of large blocks.

Some examples of damage and the wildlife responsible include:

- seed consumption (field mouse, squirrel);
- seedling browse (deer, snowshoe hare, cottontail rabbit, vole, gopher, grouse);
- pole tree stem damage (squirrel, porcupine, bear, vole, sapsucker).

Other small mammals causing damage on a limited scale are the American pika, pocket gopher, and bushy-tailed woodrat. The risk of small mammal damage can increase with vegetative cover, especially in grassy areas and

aspen thickets. Strategies to deal with small mammals include reducing post-harvest slash, planting less-susceptible species, and considering habitat enhancement for predator species (Backhouse and Manning 1996).

Strategies to deal with ungulate problems include planting non-preferred species, using mechanical barriers (Booth and Henigman 1996), and selecting microsites that obstruct feeding (obstacle planting adjacent to slash accumulations or stumps).

Further information on the control of mammal damage can be found in Chapter 22 of *Regenerating British Columbia's Forests* (Lavender et al. 1990).

Livestock damage: Livestock can trample or browse seedlings, or abrade the main stem bark. Consider whether present or future range use in the area might affect seedling performance and growth. Surrounding cutblocks can often provide clues. Communication with the range tenure holder is recommended, particularly when planting or natural regneration are contemplated.

Note that cattle typically choose the easiest route to travel (e.g., trenches). Obstacle planting (i.e., planting seedlings beside large rocks, slash, stumps) is a recommended treatment for highly grazed areas.

CLIMATIC

Air temperature extremes: The temperature of the air surrounding the seedling can be limiting at both extremes. Sites can be either too hot or prone to frost. In the former case, tree seedlings can experience stem girdling caused by excessive heat at the soil surface. In subzones with hot dry summers, seedlings are at the greatest risk of heat damage on flat or south-facing slopes. Risk of heat damage will increase with steepness on south slopes. Blackened forest floors will also increase heat loads. Heat loads can be decreased by: favouring shaded microsites; leaving a partially cut overstorey; or planting on the north side of obstructions, such as stumps, large slash, and clumps of vegetation.

Summer frost: Sub-lethal or lethal cold temperatures can occur during the growing season. This is more prevalent in the Interior. Summer frosts can occur on a calm, clear night in a dry subzone, or at higher elevations. Sites with surface organic layers and lack of vegetation are more prone to frost damage. The presence or absence of certain plant species can help delineate frost-prone areas. Frost-hardy tree species should be considered. Some forms of site preparation and vegetation management or partial cutting may help alleviate this problem. Stathers (1989) provides a thorough review of summer frost in young forest plantations.

Frost heaving: This occurs in wet mineral soils where only a thin layer freezes at the surface. Seedling stems frozen into the soil surface are lifted out of the soil by the formation of vertical ice lenses. This can occur in both the spring and fall and is more prevalent at higher elevations.

Frost heaving shears the fine roots and dries those roots exposed when the seedling is lifted. Heaving occurs more frequently on mechanically prepared sites with moist or wet, silty-textured soils that are planted with plug stock. Removal of the organic layer can also promote frost heaving.

Snow press / damage: Damage is caused by snow press, snow creep, or snow glide. Damage also occurs when long-lasting snow shortens the length of the growing season. Risk of snow damage (broken or deformed stems) is greatest where wet, heavy snowpacks undergo considerable settling, or where downslope movement of dense snowpacks occurs (the risk is highest on smooth slopes > 35%).

Snow press is common in high-elevation subzones on the Coast and in wet-belts in the Interior. Species with robust stems and branches, such as amabilis fir, subalpine fir, and spruce, can better withstand snow press.

Snow creep is movement within the snowpack that can damage tree stems. Snow glide is movement of the entire snowpack downhill. To help avoid damage to seedlings from snowpack movements, consider planting on the downslope side of stumps, and among large pieces of slash or large clumps of shrubs.

Lingering snowpacks can cause damage or mortality due to snow mould. To reduce the possibility of snow mould, select or create elevated microsites, or use similar strategies to those mentioned for snow creep.

Cold-air ponding: When air cools, it flows downslope and accumulates in level areas and depressions. These areas are at much higher risk of frost during the growing season than mid- and upper slopes. Cold-air ponding can occur both at the local level (valley bottom vs. adjacent slopes) and microsite level (depressions vs. mounds). Cold-air ponding often occurs at the bottom edge of clearcuts where air flow is blocked by the forest canopy. The establishment of frost-resistant species, or the selection or creation of elevated microsites, should be considered.

Winter desiccation: This occurs when the plant loses water to evaporation because it cannot translocate water from frozen soil, roots, or xylem. The injury is common on southern slopes where sun-exposed leaves and stems can rise above 15°C while soil temperatures remain below 0°C. Winds can contribute to desiccation of exposed foliage, especially on exposed droughty sites or in chinook-prone areas.

Wind: Areas prone to high winds (e.g., exposed mountaintops, along seashores or large lakes, converging valleys) experience increased plant evaporation and transpiration losses. Soil indicators in windy areas include weak soil profile development due to scalped (eroded) profiles, evidence of soil erosion on the windward side, soil deposition on the lee side of hills or road cuts/fills, and the presence of dunes. Vegetation indicators include strongly reduced height growth and gnarled growth form with tree tops and branches oriented downwind (Luttmerding et al. 1990). If moisture is already limited, desiccation by wind can be severe or lethal for seedlings. Wind can also cause mechanical damage.

Growing-season length: This is greatly affected by elevation and latitude. Northern latitudes and high-elevation sites generally have a short growing season because of either deep snow accumulations, which persist into the summer, or extreme climatic conditions.

Moisture deficit / drought: This occurs during a significant portion of the growing season on dry sites with coarse, well-drained soils. Drought also occurs where grass cover or other aggressive vegetation is dense. On water-deficient sites, planting close to well-decomposed wood may improve water availability for seedlings. The following landforms also contribute to drought: knolls, ridges, steep southern aspects, talus slopes, coarse-textured glaciofluvial terraces, sand dunes, shallow soils, and coarse-textured soils underlain by porous bedrock (e.g., sandstone and other sedimentary rock).

Exposed mineral soil on dry sites can lose moisture rapidly during the summer; this is particularly true for silty-textured soils, which conduct moisture to the evaporating surface through capillary action. Decomposed organic matter which is incorporated into the mineral layers, helps to hold soil moisture. Drought-tolerant species or some forms of site preparation may alleviate this problem. In hot subzones or variants, partial-cutting systems provide overhead shelter and reduce drought stress for certain species such as Douglas-fir, particularly on south-facing slopes. In clearcuts, microsites shaded by stumps, slash, or artificial shading devices may reduce transpirational losses to the seedlings.

OTHER

Vegetation (light): Sites with aggressive vegetation, such as salmonberry, thimbleberry, fireweed, bracken fern, red alder, cottonwood, and aspen, limit light available to establishing crop trees. Low light levels significantly reduce net photosynthesis and, consequently, heavily shaded seedlings accumulate little biomass, grow slowly, and have a spindly growth form. This is often a serious problem in many of the wetter subzones in British Columbia.

Vegetation (press): Herbaceous species, such as fireweed, ferns, or grass, can subject establishing crop trees to pressure from the weight of their dying foliage and stems during the fall and winter months. This press often deforms the main stem of seedlings and increases snow mould problems.

Vegetation (moisture/nutrient): Competing non-crop species can limit nutrients and moisture availability for seedlings on certain sites. Remember that nutrients are not lost from the system, but are taken up, stored, and recycled by the vegetation. The net effect may be positive for long-term site productivity. On dry sites, avoid microsites with dense grass or other aggressive vegetation.

Consider also the beneficial effects that non-crop species may have on seedlings by providing shade and thermal protection from frost, and by adding soil nitrogen. In hot, arid areas, growth and survival are improved by leaving shade for seedlings, which reduces heat stress (and increases humidity). Understanding all the limiting factors on the site is critical to the final decision for vegetation control.

The presence of vegetation-limiting factors can be mitigated by the use of appropriate silvicultural systems, pre-harvest vegetation control, site preparation, prompt planting with healthy, vigorous seedlings, or rapid brushing and weeding to prevent the seedlings from becoming weakened by overtopping brush.

Specific information on the autecology of 35 common British Columbia plants and their response to management treatments can be found in Coates et al. (1990) and Haeussler et al. (1990).

Heavy slash: Slash, if considerable, can be an impediment to regeneration. The composition (i.e., health and age) of the existing stand will often provide clues about the expected slash loading after harvest. Consider also existing dead forest fuels and cedar volumes.

EXPLAIN AND COMMENT

Several blank lines on the stratum card are provided for the surveyor to record other limiting factors. Extra space is also available to explain and comment on any of the identified limiting factors.

When all limiting factors are identified, refer to the regional ecosystem field guide and the *Establishment to Free Growing Guidebook* applicable to your forest region and select the most appropriate tree species to establish the new crop. Each tree species is tolerant of several environmental and health

factors. Matching the correct species for a particular situation can often overcome the limiting factor(s).

25. TREE ESTABLISHMENT

Indicate whether the free-growing stand will be established by natural means or by planting. The historical regeneration pattern for the area may indicate that a combination of the two is acceptable.

Indicate whether saplings (advanced regeneration) are going to contribute to the free-growing stand and describe the acceptability criteria required to meet a free-growing tree (as assessed by the surveyor, not reiterated from free-growing standards).

Natural: If reforestation is to be accomplished by natural regeneration, consider and discuss the following factors: cone distribution, seed trees, adjacent seed source, acceptable seedbed (i.e., consider forest floor depth, mineral soil exposure), seed dispersal, acceptable saplings, species providing the seed source (e.g., will they be acceptable?), pathogens (existing or potential), and windthrow hazard to seed trees.

Plant: Planting provides the opportunity to control species composition, regeneration timing, and the seed source of a future stand. To achieve high rates of seedling survival and growth performance, a careful assessment of limiting factors must be made.

If reforestation is to be accomplished by planting, consider species based on the regional ecosystem field guide. In some situations, species other than the "preferred" may be selected. When this occurs, include the rationale for the selection. If a species mix is to be used, indicate how it should be planted spatially. Also, note suitable stock type(s), any specific microsite criteria, and season of planting (spring, summer, fall).

For further information, refer to the *Provincial Seedling Stock Type Selection and Ordering Guidelines* (Scagel et al. 1993). Further comments might include whether the recommended stocking standard is reasonable, given site limiting factors and the chosen methods of harvesting, site preparation, and tree establishment.

Combination: If a combination of planting and natural regeneration is to be relied on for tree establishment, then indicate the percent contribution by each, or discuss the specific areas to which each apply.

26. SITE PREPARATION

After careful consideration of species and stock type choices, indicate whether site preparation will be necessary after harvest, and outline the

limiting factors to be mitigated. Recommend the method(s) of site preparation you feel will best address the most serious limiting factor. Indicate any constraints (i.e., site, seasonal, or timing) to the chosen method(s) of site preparation. Consider also whether site preparation will affect other identified resource values. Site preparation should create enough disturbance to overcome the limiting factors without causing excessive soil disturbance.

Site preparation can achieve any of the following:

- reduce vegetative competition
- decrease risk of frost damage
- overcome moisture problems, such as desiccation or waterlogging
- increase the temperature in the root zone
- increase available oxygen in the soil
- reduce risk of insect attack
- reduce hazard from fire
- facilitate planter access
- increase nutrient availability

For information about site preparation, refer to the *Site Preparation Guidebook*.

If prescribed fire is being considered, then provide an assessment of the sensitivity to prescribed fire using keys available in some regional ecosystem field guides or the method presented in the *Fire Management Guidebook*.

STAND TENDING

27. VEGETATION COMPETITION (BRUSHING)

Based on information collected on plots within the stratum (i.e., ITEM 22, FS 39A), indicate whether brushing can be anticipated. Note that proper site preparation, in the first place, is often the most cost-effective way to deal with competing vegetation. Provide details of the species to likely require control and the treatment method(s) (e.g., manual, chemical, grazing), and assess the constraints to the brushing treatment (e.g., topography, chemical use restrictions, soils). Indicate the optimum treatment window and possible timing after harvest.

A discussion of the control of competing vegetation can be found in Chapter 19 of *Regenerating British Columbia's Forests* (Lavender et al. 1990).

28. SPACING / PRUNING / FERTILIZATION

Spacing: When spacing is anticipated for stocking control or to meet other resource objectives, indicate the method and the approximate timing. Indicate important considerations, such as the intended stand composition

and post-spacing density, and the anticipated effects on wildlife habitat or domestic grazing opportunities.

Pruning: When pruning is required to manage white pine, meet wildlife habitat objectives, or otherwise achieve free-growing requirements, indicate the approximate timing. Indicate important considerations, such as target species, recommended knot size (if applicable), required crown retention, and forest health.

Fertilization: When fertilization is required to meet long-term timber supply objectives, or is considered advantageous to achieve a healthy free-growing stand, indicate the method (ground or aerial) and the approximate timing. Indicate target species for treatment, and whether or not screening trials are recommended.

For further coverage on the topics of pruning and fertilization, refer to the *Pruning Guidebook* and the *Forest Fertilization Guidebook*.

For all of the above, discuss any constraints to the recommended treatment(s).

RESOURCE VALUES / CONCERNS

Many of the other resource values will be identified before conducting the field assessment. However, data collected using the stratum card (FS 39B) ensure that concerns identified at higher levels of planning continue to be carried through to the operational phase. The surveyor(s) must assess all existing planning and resource information so that any concerns can be addressed and verified in the field. Consider resource values both in, and adjacent to, the stratum.

29. PLANT DIVERSITY

Describe the attributes of the existing plant community. These attributes may include wildlife trees (Figure 32), coarse woody debris, standing dead trees, large living trees, and special vegetative habitats.

- ***Coarse woody debris (CWD)*** – Decaying logs on the forest floor provide cover, microclimates, and breeding habitat for a variety of organisms. These organisms include vertebrates, fungi, invertebrates, lichens, plants, and micro-organisms. Woody debris should be retained in the stand, within utilization standards. Larger-sized pieces are preferable, as they provide the greatest longevity and potential for nutrient cycling and wildlife use in the second-growth forests. Coarse woody debris is rarely evenly distributed, but it should be as well distributed as possible throughout the block. In drier ecosystems, much of the forest floor is

British Columbia's wildlife tree classification system

Decay class	LIVE		DEAD				DEAD FALLEN		
	1	2	3	4	5	6	7	8	9
Description	Live/healthy no decay; tree has valuable habitat characteristics such as large, clustered or gnarled branches or horizontal, thicky moss-covered branches. •	Live/unhealthy internal decay or growth deformities (including insect damage, broken tops); dying tree. •	Dead needles and twigs present; roots healthy.	Dead no needles/twigs; 50% of branches lost; loose bark; top usually broken; roots stable.	Dead most branches/bark absent; some internal decay; roots of larger trees stable.	Dead no branches or bark; sapwood/heartwood slough-ing from upper bole; decay more advanced; lateral roots of larger ones sotening; smaller ones unstable.	Dead extensive internal decay; outer shell may be hard; lateral roots completely decomposed; hollow or nearly hollow shells.	approx.1/3 original height	Debris downed trees or stumps.
Uses and users	Nesting (e.g., bald eagle, great blue heron colonies, marbled murrelet); feeding; roosting; perching	Nesting/roosting[1] -strong PCEs[2] (woodpeckers); SCUs[3]; large-limb and platform ness (ospreys); insect feeders.	Nesting/roosting-strong PCEs; SCUs; bats.	Nesting/roosting-PCEs; SCUs; insect feeders.	Nesting/roosting-weak PCEs (nuthatches, chickadees); SCUs; bats; insect feeders.	Weaker PCEs; SCUs; insect feeders; salamanders; small mammals; hunting perches.	Insect feeders; salamanders; small mammals; hunting perches; occasionally used by weak cavity excavators such as chickadees.		Insect feeders; salamanders; small mammals; drumming logs for grouse; flicker foraging; nutrient source.

1 Large witches' brooms provide nesting/denning habitat for some species (e.g., fisher, squirrel).
2 PCE = primary cavity excavator
3 SCU = secondary cavity user
• This classification system does not recognize root disease trees specifically. Such trees become unstable at or before death.

FIGURE 32 *British Columbia's wildlife tree classification system (Fenger and Chatwin 1995).*

derived from CWD, which needs to be maintained on-site. Will enough be left? How will new CWD be recruited during the rotation?

- ***Standing dead trees*** – Standing dead trees provide nesting and foraging habitat for a wide range of species. Providing wildlife trees in managed forests is probably the most important stand management practice for maintaining above-ground biodiversity. Some existing wildlife trees should be retained, but equally important is the recruitment of wildlife trees into the stand. Small-diameter wildlife trees are adequate for some species, but large-diameter wildlife trees are required by other species, and they endure longer (see *Landscape Unit Planning Guide*, "Wildlife Tree Retention").

  Techniques to maintain an adequate number of wildlife trees and provide future wildlife trees in managed stands include:

  - Retaining some wildlife trees during harvesting, where it is safe to do so (within wildlife tree reserve areas and along block boundaries).
  - Retaining some live trees during harvesting as a source of large-diameter wildlife trees in the subsequent rotation.
  - Promoting a deciduous component in the stand as a source of wildlife trees.
  - Retaining wildlife trees during spacing and thinning (where it is safe to do so).
  - Creating wildlife trees.

- ***Large living trees*** – Large, old, living trees provide several unique habitat attributes and should be retained. For example, large mossy limbs provide marbled murrelet nest sites and habitat for numerous invertebrate species. Arboreal lichens and other epiphytes are most abundant in older trees. Large living trees also provide a source of future wildlife trees.

  Such trees can be retained through a variety of silvicultural systems and harvesting activities. Wildlife tree patches established to maintain snags are also good areas for retaining large living trees.

  Note: *Do not retain or create wildlife trees close to permanent access routes where they may fall, or be cut for firewood.*

> **SAFETY FIRST**
> Safe work practices must always be the first consideration in any wildlife tree management prescription. Single-stem safety assessment procedures are contained in the *Wildlife/Danger Tree Assessor's Course Workbook*. Further details are also provided in the *Partial-cutting Safety Handbook* (B.C. Ministry of Forests 1996).

Special vegetative habitats – Patches of deciduous trees, willow thickets, and meadows are all examples of special habitats. These should be identified as separate strata, if large enough, or excluded from harvesting or silvicultural operations.

Maintaining tree species diversity, along with structural diversity, is also a necessary consideration in managing for plant diversity. Discuss how these attributes will be maintained, or how they will be restored.

- ***Tree species diversity*** – An ecologically appropriate variety of tree species, including hardwoods, should be retained in a stand. Such diversity can meet the habitat requirements for a greater variety of organisms than could be met in a homogeneous stand. Tree species composition can be managed through the silvicultural system by choice of harvesting, site preparation, planting, regeneration, and stand-tending activities.

- ***Structural diversity*** – A variety of canopy layers (vertical structure) and spatial patchiness (horizontal structure) are important attributes for maintaining biological diversity. This variety of layers includes the naturally occurring forest understorey of shrubs and forbs, which provide food and cover for numerous species. To maintain understorey vegetation, a partially open or patchy forest canopy is required. Structural variety creates more habitat and microclimate diversity than homogeneous stands.

  Vertical and horizontal structural diversity can be maintained or created through the silvicultural system by choosing appropriate harvesting methods, stocking levels, and stand-tending activities. Even-aged systems tend to create structural variety between stands that are at different seral stages, whereas uneven-aged systems tend to create structural variation within single stands. With either method, structural variety changes as forests grow.

To maintain desired stand-level characteristics into the future, it is important to work with the attributes already present in each stand. High-value habitat features (e.g., large live trees, or large snags along riparian area) should be identified, and retained where it is safe to do so. Consult the Ministry of Environment, Lands and Parks published lists of rare plant associations to determine whether any are present within the stratum. Further information on stand-level management practices to maintain biodiversity can be found in the *Landscape Unit Planning Guide*.

30. FAUNAL DIVERSITY

Assess and record the existence of fauna and their habitat from evidence found within, or adjacent to, the stratum. Note the presence of tracks,

burrows, nests, dens, runways in the grass, feeding sign, game trails, artifacts (e.g., feathers, hair, shed skins, cast antlers), droppings, etc. Assess the abundance of attributes (raptor nests, occupied snags, arboreal lichens, winter range) that may be of particular importance to fauna.

Identify all faunal species present (e.g., ungulates, amphibians, reptiles, game and non-game birds, and small mammals). If possible, determine whether habitat is critical for rare or endangered species. Consult the *Identified Wildlife Management Strategy* for specific measures to address these species.

Also, assess the effect that timber harvesting will have on the identified values.

31. FIRST NATIONS / TRADITIONAL USE / CULTURAL HERITAGE

Note any evidence of undocumented artifacts, features, or sites found within, or adjacent to, the stratum. Artifacts are objects; features are structures, such as hearths, houses, and storage pits; sites can include (but are not limited to) kill sites, habitation sites, and burial sites.

The following clues outline what to look for (these may vary between the Coast and Interior).

- Shallow concave depressions with a circular or nearly circular circumference. These depressions are often grass covered from past ground disturbance, but can have trees growing within them (i.e., plant succession since occupation). These depressions could be house pits or cache pits. House pits (i.e., lodgings) were generally located near winter camp sites and were usually one terrace up from a water body. Cache pits, used for storing foods, are much smaller than house pits, and usually several are found in the proximity of a winter camp site.
- Rocks piled together on a slope may be evidence of an old deer blind used for eluding deer when hunting.
- Petroglyphs (carvings) etched into rock.
- Pictographs (drawings or paintings) on rock, usually of red, black, yellow, white, or green colours. Red is the most common colour, with black the next most common. Pictographs are usually found on rocks that could not normally be moved. Often, two small rocks were placed on top of the pictograph rock. If they are no longer present, you may see two small depressions where they once were located. More information on this subject can be found in Corner (1968).
- The following might be evidence of culturally modified trees: horizontal lines around a tree where bark was stripped when deer were hung between two nearby trees; a cat face on a pine tree where sap was extracted for eating; a blaze (often at breast height) to mark a trail (these blazes will often be located along the same side of the trail).

- Old Douglas-fir leading stands (i.e., age class 9) were often used to collect lichen for making candy and needle gathering to extract sugars. These areas would be considered as traditional use areas.
- Areas used for hunting and gathering plants for food and traditional use.

***Note**: Be aware that many First Nations leaders have concerns about operational plan maps showing the location of artifacts and features found in the area. Before preparing the SP, contact the Ministry of Forests district office to find out what policies are in place regarding how these resources must be accommodated. Also determine whether or not (or how) these resources should be referenced in the SP (or other operational plans).*

For further information on this topic, refer to Section 2.1 of this handbook.

32. LANDSCAPE / RECREATION

Assess the existing recreation feature(s), if any, in the stratum. The visual landscape and recreation resources noted within, and near, a cutblock or opening must be described on the basis of definitions and procedures provided in the *Ministry of Forests Recreation Manual* and the *Visual Impact Assessment Guidebook*.

If there is a question about an assessment, consult the Resource Officer (Recreation) in the district office. For further information on this topic, refer to Section 2.1 of this handbook.

33. OTHER

Indicate whether there is any evidence of unidentified resource values. This could include water improvements, artificial structures, rare plants or plant communities, animal traps, mining claim tags, and evidence of use (e.g., horse trails, trail blazes, botanical product picking) by any particular groups or individuals.

34. RANGE

If there are no existing range agreements or range developments within, or adjacent to, the stratum or cutblock, this section can be recorded as not applicable. Otherwise, assess the existing range values and consider the value of grass seeding.

Determine whether the site is a permanent range ecosystem (i.e., it provides substantial herbaceous forage throughout most or all successional sequences). Sources of information for this assessment may include ecosystem mapping, district mapping of permanent range, district range staff, ecosystem descriptions in the regional ecosystem field guides, and characteristics of the site (e.g., herbaceous forage, soil classification, Ah horizons, mull humus

forms). Consider the effects of forest treatment selection on permanent range. Historic range values would have been generally high in naturally open, generally uneven-aged forest stands. Maintaining this type of stand structure is recommended for permanent range ecosystems.

In the field, note the level of grazing use (forage removal), and estimate the effects livestock will have on regeneration establishment and survival (see also ITEM 24). Adjacent areas can provide helpful clues to the effects of grazing on regeneration.

Consider whether the harvesting of the proposed cutblock will breach an historic natural barrier to cattle movement. Cattle management and regeneration problems may result if cattle movements are not otherwise controlled. The Forest Practices Code requires that anyone who removes or renders ineffective a natural range barrier must take measures specified by the district manager to mitigate the effects of such activities.

Grass seeding: Assess whether grass seeding would be acceptable. If so, indicate specifically where (landings, roadside, whole cutblock, etc.) to seed grasses. Be sure to consider the effect of grass seeding on seedling establishment.

Seeding grasses can minimize erosion and weed infestation, enhance the nutrient supply on a site through nitrogen additions (where clover is in the mix), improve soil structure, and provide forage for livestock. If sites are prescribed for seeding, they should be seeded immediately after disturbance. The longer the delay, the greater the potential for soil erosion, site degradation, cementing of soils, and growth of undesirable vegetation, including noxious weeds. The use of native seed is suggested in the *Biodiversity Guidebook*; also check the *Landscape Unit Planning Guide*. Weigh these considerations carefully against your chosen method of regeneration.

For information about range, refer to the *Ministry of Forests Range Manual*, and the *Range Management Guidebook*.

4 SUMMARY

Preparation of a silviculture prescription as required under the *Silviculture Practices Regulation* relies heavily on the ability of the surveyor to collect and assimilate field data. This handbook provides a framework for collecting technically accurate, meaningful information. As with all guides, it must be used with discretion so that the type of data collected, and the level of detail provided, are appropriate to the user's needs.

APPENDIX 1 Silviculture prescription terminology

Anadromous – Fish that breed in fresh water, but live their adult life in the sea. On the Pacific Coast, anadromous fish include all the Pacific salmon, steelhead trout, some cutthroat trout and Dolly Varden char, lampreys, and eulachons.

Archaeological resource – Any locality that exhibits physical evidence of the past activities of a person or group of people for which the scientific methods of inquiry are the main source of information.

Aspect – Measures the orientation of a slope by means of compass points and indicates whether the slope is exposed to the north, south, east, or west, or any point between. Level ground has no aspect.

Blowdown (Windthrow) – Uprooting by the wind, as in tree or trees so uprooted.

Blue-listed specie(s) – Any indigenous species or subspecies (taxa) considered to be vulnerable in British Columbia. Vulnerable taxa are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed taxa are at risk, but are not extirpated, endangered, or threatened.

Brushing – A silviculture activity conducted by manual, chemical, grazing, or mechanical means to control competing vegetation and to reduce competition for space, light, moisture, and nutrients with crop trees or seedlings. May also be useful in reducing mechanical damage, such as snow press, to crop trees.

Climax – In the context of ecosystems, characterizes a self-perpetuating community whose species composition is expected to be relatively stable and long term.

Coarse woody debris – Sound and rotting logs and stumps that provide habitat for plants, animals, and insects and a source of nutrients for soil development. Material generally greater than 7.5 cm in diameter.

Coast – The geographic area contained in the Vancouver Forest Region and the North Coast and Kalum forest districts within the Prince Rupert Forest Region.

Colluvial – Material produced by mass wasting or downhill movement and transported by agents other than running water. Colluvial materials include the debris of shattered bedrock, landslide deposits, and mudflows.

Community watershed – A watershed with a drainage area no greater than 500 km^2 that is licensed under the *Water Act* for community water use; or for domestic water use and the holder of the licence, the district manager, the designated environment official, and the Minister of Health all agree that the area should be regarded as a community watershed.

Competing vegetation – Vegetation that competes for the limited common resources (space, light, water, and nutrients) of a forest site, which are needed by future crop trees for survival and growth. It may also cause mechanical damage (similar to snow press) to crop trees.

Critical site conditions – The silviculture prescription must state any critical site conditions that affect the timing of operations, and describe how operations are affected. Only those site conditions directly related to a prescribed action, or limitations to an action, must be stated. Such conditions may be related to soil properties, drainage, periodic flooding, wildlife (e.g., nesting periods), recreational activities (e.g., hunting or fishing seasons), or any other site conditions critical to the success of the prescription.

Crop tree – A tree in a young stand or plantation selected to be carried through to maturity until an interim or final harvest.

Cultural heritage resource – An object or a site, or the location of a traditional societal practice that is of historical, cultural, or archaeological significance to the Province, a community, or an Aboriginal people.

Cutblock – A specific area, with defined boundaries, within which timber is authorized to be, or has been, harvested.

Ecosystem – A segment of the landscape that is relatively uniform in its composition and structure, and in the properties of its vegetation, animals, and physical environment, and in their interactions.

Ecosystem field guide – A Ministry of Forests Land Management Handbook available for each forest region that provides a guide to site identification and interpretation based on the Biogeoclimatic Ecosystem Classification (BEC) system developed by Dr. V.J. Krajina and adopted, modified, and expanded by the Ministry of Forests. Consult the *Silviculture Prescription Guidebook* for the appropriate field guide in your region.

Edaphic – Relating to, or determined by, conditions of the soil.

Environmental strata – Map strata that delineate differing environmental and ecological factors. The most common include physiographic factors

(e.g., aspect, slope, terrain, and landforms), biogeoclimatic (BEC) site series, and forest cover.

Eolian – Deposited by wind. Eolian materials (sands and silts) can occur anywhere, even in the alpine, but they are thickest and most extensive on terraces, fans, floodplains, and outwash surfaces.

Ephemeral stream – A stream that does not run year-round.

Field recommendations – Written descriptions of the potential techniques and treatments that can be used to accommodate other resource users and achieve a free-growing stand. Field recommendations are developed at the same time as field data are collected.

Fire hazard – The potential fire behaviour for a fuel type, regardless of its weather-influenced fuel moisture content or its resistance to fireguard construction. Fire hazard assessment is based on physical fuel characteristics (e.g., fuel arrangement, fuel load), condition of herbaceous or shrub vegetation, and presence of elevated fuels.

Fisheries-sensitive zones (see the *Timber Harvesting Practices Regulation*) – A flooded depression, pond, or swamp, that:

- either perennially or seasonally contains water, and
- is seasonally occupied by a species of fish listed in the definition of "fish stream" in the *Operational Planning Regulation*, see Riparian/Watershed Values section in front of ITEM **13,** STREAMS, p. 80.
- but does not include a wetland or lake that has a riparian management area established under Part 8 of the *Operational Planning Regulation*, or a stream.

Fish stream – Any stream reach frequented by any of the following species: anadromous salmonids, rainbow trout, cutthroat trout, brown trout, bull trout, Dolly Varden char, lake trout, brook trout, Kokanee, largemouth bass, smallmouth bass, mountain whitefish, lake whitefish, arctic grayling, burbot, white sturgeon, black crappie, yellow perch, walleye, northern pike, or identified threatened, endangered, or regionally important fish determined under of the provisions in the Operational Planning Regulation.

All reaches of streams that have a slope gradient of less than 20% must be identified and mapped as fish streams, unless a fish inventory, carried out in accordance to the *Fish-stream Identification Guidebook*, demonstrates that none of the fish species listed above is present. (If further guidance is required, contact the local Ministry of Environment representative.) This 20% gradient rule for "default" fish-bearing status does not apply when the following three conditions occur:

- the stream is located upstream of a known barrier to fish passage, identified on a fish and fish habitat inventory map;
- all reaches upstream of the barrier are simultaneously dry at any time of the year; and
- no perennial fish habitats exist upstream of the barrier.

Floodplain – Level land bordering a stream or river and subject to flooding.

Fluvial – Produced by river or stream action. Fluvial materials consist of gravel, sand, or silt, and are generally well sorted when compared to most other surficial material.

Folisols – Organic soils composed of upland organic materials, generally of forest origin, that are thicker than 40 cm, or are at least 10 cm thick if lying over bedrock or fragmental material.

Forest cover map – A map showing relatively homogeneous forest stands or cover types, produced from the interpretation of aerial photos and information collected in field surveys. Commonly includes information on species, age class, height class, site, and stocking level.

Forest development plan – An operational plan guided by the principles of integrated resource management (the consideration of timber and non-timber values), which details the logistics of timber development over a period of usually 5 years. Methods, schedules, and responsibilities for accessing, harvesting, renewing, and protecting the resource are set out to enable site-specific operations to proceed.

Forest health factors (agents) – Biotic and abiotic influences on the forest that are usually a naturally occurring component of forest ecosystems. Biotic influences include fungi, insects, plants, animals, bacteria, and nematodes. Abiotic influences include frost, snow, fire, wind, sun, drought, nutrients, and human-caused injury.

Forest Practices Code (FPC) – Includes the *Forest Practices Code of British Columbia Act*, Regulations, standards, and guidebooks that govern forest practices in British Columbia.

Glaciofluvial – Streams flowing from glaciers or the deposits made by such streams. Can be less sorted than fluvial deposits.

Glaciolacustrine – Produced by proglacial lakes during or shortly after deglaciation. Sediment is brought into the lakes by meltwater streams. Silt and fine sand are the most common materials, but coarser sand and gravel occur close to points of inflow.

Gradient (stream) – The general slope, or rate of vertical drop per unit of length, of a flowing stream.

Granitic rock – A coarse-grained igneous rock consisting of quartz, feldspar, and mica or other coloured minerals that cooled slowly below the earth's surface.

Guideline – A generally accepted practice developed to accommodate most common management situations.

Heritage areas – Sites of historical, architectural, archeological, paleontological, or scenic significance to the Province.

Higher-level plans – Refer to plans or portions of plans, agreements, or objectives as defined in the *Forest Practices Code of British Columbia Act* and declared by the Lieutenant-Governor-in-Council or the ministers as a higher-level plan. Higher-level plans establish the broader, strategic context for operational plans by providing objectives for managing a mix of forest resources for a given area.

Igneous rock – A rock that has solidified from molten or partly molten materials (magma). Includes granitic rocks that have cooled slowly below the surface (coarse grains), and basaltic rocks that have cooled quickly at the earth's surface (fine grains).

Incidence (of pests) – The proportion (0–1) or percentage (0–100%) of damage agent–affected sampling entities (normally a tree) within a sampling unit (normally a plot or stratum). To avoid confusion when using incidence, always indicate the sampling entity and sampling unit in order to ensure clarity.

Interior – The geographic area contained in the Cariboo, Prince George, Kamloops, and Nelson forest regions, as well as the Bulkley, Cassiar, Kispiox, Lakes, and Morice forest districts of the Prince Rupert Forest Region; the geographic area that is not the Coast.

Interpretive units – Map strata that delineate differing management strategies or site attributes. The most common of these include: Standards Units, treatment units, site sensitivity, slope categories, visual sensitivity, etc. These strata may be observable or may be an artificial delineation based on management implications (e.g., a 200 m reserve from a known source). Some interpretive units may come from other maps, plans, or documents and the exact location may be a matter of judgement.

Lacustrine – Produced by, or belonging to, lakes.

Landform – A landscape unit that denotes geologic parent material origin and shape (e.g., floodplain, river terrace, or till plain).

Landscape inventory – The identification, classification, and recording of the location and quality of visual resources and values.

Landscape sensitivity – A component of the landscape inventory that estimates the sensitivity of the landscape based on the visual prominence or importance of features, the conditions that affect visual perception, and social factors that contribute to viewer perceptions.

Limestone rock – A sedimentary rock consisting chiefly of calcium carbonate ($CaCO_3$), which fizzes when 10% hydrochloric acid is applied to it.

Logging – Forest harvesting activities including falling, yarding, and hauling (as well as road building).

Mappable unit – An area that can be stratified and identified on a map. This will vary with scale. For many regions, it is defined as one hectare at a scale of 1:15 000. When necessary, units of less than 1 ha can be mapped out at a scale of 1:5000. Where differing mappable units are not mapped separately, *the most limiting factors within the map strata are to be used when developing prescriptions.*

Mature layer – The layer of trees that have a stem diameter of 12.5 cm or greater, measured at a height of 1.3 m.

Metamorphic rock – Rocks that have formed in response to pronounced changes in the temperature, pressure, and chemical environment. Metamorphic rocks are produced by internal processes within the earth.

Microsite – A portion of a site that is uniform in microtopography and surface soil materials. It can range in size from less than 1 m^2 to occasionally over 5 m^2. Microsites change over time with climatic and management influences.

Morainal – Deposits originating from glacier ice. Laid down from the base, ends, sides, or melting surface of glacial ice sheets.

Mottles – Spots or blotches of different colour, or shades of colour, interspersed with the dominant colour of the soil matrix. Usually indicates a fluctuating water table.

Natural regeneration – The renewal of a forest stand by natural (e.g., seed on site, seed from adjacent stands, or seed deposited by wind, birds, or animals) rather than human means.

Noxious weed – Any weed(s) designated by the *Weed Control Regulation* and identified on a Regional District Noxious Weed Control list.

Opening – An area denuded of trees by means of harvesting, insects, disease, fire, wind, flooding, landslide, contravention of the *Forest Act* or *Forest Practices Code of British Columbia Act*, or any other similar means.

Parent material – The unaltered, or essentially unaltered, mineral or organic material from which the soil profile develops.

Perennial stream – A stream that has flowing water all year.

Pest – Any forest health agent designated as detrimental to effective resource management.

Physical features – An area, object, or condition that cannot be stratified (i.e., enclosed by a polygon) at the chosen map scale. The location of these is normally shown by using symbols (roads, fences, buildings, streams, cliffs, etc.). The symbols for most features are provided in the Ministry of Forests *Visual Identifier Standards Guidebook*.

Plant association – A community of plants. Examples of some common plant associations are: hemlock–amabilis fir–vaccinium; cedar–spruce–salmonberry; black spruce–sphagnum–Labrador tea. A plant association is generally comprised of at least the three most abundant species found growing on a site, with at least one representative from the tree layer and one or more representatives from either the shrub, herb, or bryophyte layers. Although plant associations are influenced by site series, any one site series may support numerous possible plant associations. Therefore, it is difficult to infer plant association from site series, or even site series from plant associations.

Plot – In the silviculture prescription context, a collection of data, normally within a single site series. On occasion, it may comprise two or more unmappable site series occurring within a compound stratum. The dimensions or radius of the plot will vary based on the parameter being described.

Pole layer – A layer of trees that have a stem diameter greater than or equal to 7.5 cm, but less than 12.5 cm, measured at a height of 1.3 m.

Reach – A length of a watercourse having similar channel morphology, channel dimension, and gradient.

Recreation feature – Biological, physical, cultural, or historic feature that has an ability to attract and sustain recreational use.

Recreation opportunity spectrum – A mix of outdoor settings based on remoteness, area size, and evidence of humans, which allows for a variety of recreation activities and experiences. The descriptions used to classify the settings are on a continuum and are described as rural, roaded resource, semi-primitive motorized, semi-primitive non-motorized, or primitive.

Red-listed specie(s) – Any indigenous species or subspecies (taxa) considered to be extirpated, endangered, or threatened in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reserved. Red-listed taxa include those that have been, or are being, evaluated for these designations.

Regeneration layer – The layer of trees that are less than 1.3 m in height.

Regime (treatment regime) – Regime of silviculture treatments that can reasonably be expected to produce the target stocking levels specified in the silviculture prescription by the end of the free growing assessment period specified in the silviculture prescription, as required by the *Silviculture Practices Regulation.*

Reserve – Forested patches or individual trees retained during harvesting, or other forestry operations, to provide habitat, scenic, biodiversity, regeneration, or other values. Reserves are intended to be retained for at least one rotation; in some cases, even longer.

Resident fish – Fish that remain in fresh water throughout their life cycle (i.e., non-anadromous).

Residual trees – The trees remaining after timber harvesting and any post-harvesting treatments.

Resource values – Products or commodities associated with forest lands that largely depend on ecological processes. These include, but are not limited to, water quality and quantity, forage, fish, wildlife, timber, recreation, energy, minerals, and cultural and heritage resources.

Rhizogenous – Originating in root or root-like material.

Riparian area – The land adjacent to the normal high water mark of a stream, river, or lake, extending to the portion of land that is influenced by the presence of the adjacent ponded or channelled water. Riparian areas typically exemplify a rich and diverse vegetative mosaic reflecting the influence of available surface water.

Riparian Reserve Zone (RRZ) – An area of specified width located adjacent to a stream, wetland, or lake within a Riparian Management Area, as determined by Part 8 of the *Operational Planning Regulation* (see "Note" below). Harvesting is not permitted except in special circumstances that require joint approval by the district manager and a designated BC Environment official.

Riparian Management Zone (RMZ) – An area of specified width located adjacent to any riparian reserve zone, or if there is no riparian reserve zone, located adjacent to a stream, wetland, or lake within a Riparian Management Area as determined by Part 8 of the *Operational Planning Regulation* . Constraints to forest practices apply.

Rotation – The planned number of years between the regeneration of a tree crop or stand and its final cutting at a specified stage of maturity.

Salvage harvesting – Logging operations specifically designed to recover damaged timber (dead or in poor condition), but still yield a wood product. Often carried out after fire, insect attack, or windthrow.

Sapling layer – The layer of trees that have a stem diameter of less than 7.5 cm measured at a height of 1.3 m. Previously referred to as advanced regeneration.

Sedimentary rock – Rock formed by the accumulation of sediment in water or from air. Sedimentary rocks are formed by processes that are active at the earth's surface. A characteristic feature of sedimentary deposits is a layered structure known as bedding or stratification.

Selection harvesting – An uneven-aged silvicultural system in which trees are harvested individually or in small groups continuously at relatively short intervals.

Sensitive slopes – Any slope identified as prone to mass wasting.

Sensitive soils – Forest land areas that have a moderate to very high hazard for soil compaction, erosion, displacement, mass wasting or forest floor displacement.

Silviculture prescription (SP) – A documented process for collecting site-specific field data, and establishing site-specific management objectives and standards for producing a free-growing stand. A Silviculture Prescription is a legal requirement under Sections 22 and 23 of the *Forest Practices Code of British Columbia Act.* The content requirements are specified in the *Operational Planning Regulation.*

Silvicultural system – A planned program of treatments for the entire rotation of a stand, including harvesting, regeneration, and stand-tending.

Site preparation – Planned soil and ground vegetation disturbance through the use of machinery or prescribed fire (as much as necessary, but as little as possible) to prepare the soil surface as a favourable seedbed for either naturally or artificially disseminated seed or for planted seedlings.

Site sensitivity – An assessment of the inherent susceptibility of a site to reduced productivity by forest management activities.

Site series – A landscape position consisting of a unique combination of soil edaphic features, primarily soil nutrient and moisture regimes, within a biogeoclimatic subzone or variant. These two features define a site series that can produce various plant associations (see definition of "plant association"). In the BEC system, identified as a number (e.g., 02).

Site type – Soil texture, slope, aspect, parent material and slope gradient may also be highly variable within the range of ecosystems representing a single site series. To accomodate more site-specific interpretations (and communication of experience within a local operating area), the site series can be partitioned into site types based on one or more specific soil factors and/or physiographic features.

Slash – The tree residue left on the ground as a result of trees or other vegetation being altered by forest practices or other land-use activities. Slash includes logs, splinters or chips, tree branches and tops, uprooted stumps, and broken or uprooted trees or shrubs.

Slide – A mass movement process in which slope failure occurs along one or more slip surfaces and in which the unit generally disintegrates into a jumbled mass en route to its depositional site. A debris flow or torrent flow may occur if enough water is present in the mass.

Slump – A mass movement process in which slope failure usually occurs on a curved slip surface and the unit moves downslope as an intact block, frequently rotating outward at the bottom. Slumps appear as discrete block movements, often in place, whereas slides usually break up and travel downslope.

Soil association – A sequence of soils of about the same age, derived from similar parent materials, and occurring under similar climatic conditions, but having different characteristics due to variation in relief and drainage.

Soil check pit – An excavation through the forest floor and into the mineral soil, that is only of sufficient depth to determine that the texture in the top

30 cm, apparent soil development, and parent material are similar enough to the last sampled "full" soil pit within a stratum, to justify that another plot is not required.

Soil hazard assessment – An assessment of the susceptibility of a soil to adverse impacts on its productive capability due to soil compaction, soil puddling, surface erosion, mineral soil displacement, mass wasting, or forest floor displacement.

Soil pit – An excavation into the mineral soil that is of sufficient depth to allow a soil hazard assessment and to characterize the variability in soil physical properties within a defined area of land.

Spacing – The removal of undesirable trees within a young stand to control stocking, to maintain or improve growth or health, to increase wood quality and value, or to achieve other resource management objectives including species diversity.

Stand – An even- or uneven-aged community of trees sufficiently uniform in species composition, arrangement, and condition to be distinguishable as a group from the forest or other growth on the adjoining area, and thus forming a silviculture or management entity.

Stand structure – The distribution of trees in a stand, which can be described by species, vertical or horizontal spatial patterns, size of trees or tree parts, age, or a combination of these.

Standards Unit (SU) – An area that will be managed through the uniform application of silvicultural system, stocking standards, and soil conservation standards. These standards will be used to determine if regeneration, free-growing, and soil conservation obligations are met. Standards Units are normally used to develop strata within an SP and are mappable.

Stocking – A measure of the area occupied by trees, usually measured in terms of well-spaced trees per hectare, or basal area per hectare, relative to an optimum or desired level.

Stocking standard – The required range, in species composition, density, and heights, of healthy, well-spaced, preferred, and acceptable trees.

Stratum (singular) (plural: strata) – A general term applied to an area that is a logical expression of relatively uniform environmental, and interpretive characteristics. Examples include SUs or BEC site series of 1 ha and larger. By definition they are different and therefore are based on separate sets of field data.

Stream – Any reach, flowing on a perennial or seasonal basis, with a continuous channel bed (whether or not the bed or banks of the reach are locally obscured by overhanging or bridging vegetation or soil mats) that is either scoured by water or contains observable deposits of mineral alluvium.

Stream bank – The rising ground bordering a stream channel.

Streambed – The bottom of the stream below the usual water surface.

Stream channel width – The horizontal distance between the tops of the stream banks as determined by the normal high water mark on opposite sides of the stream, measured at right angles to the general orientation of the banks.

Stream gradient – The general slope, or rate of vertical drop per unit of length, of a flowing stream.

Surveyor – In the context of this handbook, the person conducting the examination and comprehensive collection of on-site data for a silviculture prescription.

Tenure holder – An individual, group, or company that holds a licence agreement, as defined in Section 10 of the *Forest Act*, or Section 3 of the *Range Act*.

Terrain stability assessment – An assessment or characterization of unstable, or potentially unstable, slopes on forested lands. A determination of the relative potential of landslide initiation and the type of landslide that may occur on different types of terrain, based on the data obtained from the review of available maps, photos, site data, and field observations.

Texture – In soil, texture refers to the relative proportions of sand, silt, and clay particles less than 2 mm in size.

Threatened / endangered species – Species identified as "red listed" by the B.C. Ministry of Environment, Lands and Parks. Indigenous species that are either threatened or endangered.

Tolerance – The allowable variation in the accuracy of the data or description that will be used for audit or review purposes. Tolerances are used in situations where a distinction is necessary between natural variability and error. Tolerances may be applied by the surveyor who wishes to indicate specific criteria under which the information can be interpreted to be either correct or incorrect. Specifications of tolerances are generally not

mandatory, except where specifically required under the Forest Practices Code, and are left to the discretion of the surveyor.

Traditional use site – Any geographically defined site that has been traditionally used by one or more groups of people for certain types of activities. These sites often lack the physical evidence of human-made artifacts or structure, but will maintain cultural significance to a living community of people. Traditional use sites are usually documented with the assistance of oral, historical, and archival sources. Examples include: sacred sites, resource-gathering sites such as berry grounds, and sites of legendary or past events of cultural significance.

Treatment unit (TU) – An area within a cutblock that is managed through uniform application of harvesting techniques or silviculture treatments, or both. Stratification for treatment units commonly occurs after regeneration surveys have identified areas that require specific treatments. Treatment units are normally used to develop treatment plans or contracts and are not generally used to develop SPs.

Understorey – Any plants growing under the canopy formed by another layer of plants; in particular, herbaceous, bryophyte, shrub, and grass vegetation under a tree canopy.

Upland areas – Terrain not affected by water table or surface water, or else affected only for short periods so that riparian (hydrophilic) vegetation or aquatic processes do not persist.

Veterans (Vets) – The layer of trees with less than 6% crown closure that are more than 40 years older than the mature layer. Veterans are usually isolated in distribution and may extend well above the main tree canopy.

Visual quality objectives (VQOs) – Objectives or targets for managing visual values (i.e., "what we see") that represent a spectrum of allowable visual change ranging from no change due to forest management activities to maximum allowable change. Visual change or visual impact is measured against the natural-appearing landscape. VQOs are also an indication of the amount of visual impact that is publicly acceptable. They may evolve over time because of changing access, changing levels of public viewing, creation of new viewpoints, changes in vegetation screening, and changes in public concerns and social attitudes.

Volcanic rock – Rock resulting from volcanic activity (e.g., lava, volcanic glass, pumice, and certain pyroclastic rocks).

Watercourse – A natural stream or source or supply of water, whether usually containing water or not, such as a lake, river, creek, spring, ravine, swamp, or gully.

Wetland complex – A wetland complex consists of two or more individual wetlands with overlapping riparian management areas and a combined wetland area of 5 ha or more. Two wetlands have overlapping riparian management areas if they are:

- separated by 60 m or less and both are <5 ha, or
- separated by 80 m or less if one is <5 ha and the other is >5 ha, or
- separated by 100 m or less if both are >5 ha.

The individual wetlands of a wetland complex should be sufficiently large that they would otherwise be classed as W1, W2, W3, or W4. Wetland complexes have a riparian class of W5.

Zoogenous – Originating in or produced by animals.

BRITISH COLUMBIA

SILVICULTURE PRESCRIPTION PLOT CARD

NUMBERS REFER TO LAND MANAGEMENT HANDBOOK 47

REF.

1. LICENCE NO.	2. LICENSEE	3. C.P.	4. BLOCK	5. STRATUM	6. PLOT NO.

7. SURVEYOR(S) *(PRINT)*	YYYY - MM - DD	8. LOCATION

SITE

9. ELEVATION (m)	10. ASPECT	11. SLOPE %	12. BGC ZONE	SUB.	VAR.	PH.	SITE SERIES	13. MOIST.	14. NUT.

15. SLOPE POSITION	16. SURFACE SHAPE	17. SLOPE LEN. / UNIF.	18. SLOPE CONT	19. GULLIES/100m
☐ crest ☐ middle ☐ toe ☐ level	☐ convex ☐ straight	☐ short ☐ broken	☐ discontinuous	☐ ☐ ☐ ☐
☐ upper ☐ lower ☐ depression	☐ concave ☐ hummocky	☐ long ☐ uniform	☐ continuous	0 1 2 >2

UNDERSTOREY

20. UNDERSTOREY (INDICATOR / ABUNDANT SPECIES) (Area 20 m x 20 m² or ___ x ___ m)

LAYER	% C	SPECIES	% C	SPECIES	% C	SPECIES	% C	SPECIES	% C	SPECIES	% C
SHRUB											
HERB											
MOSS											

LAYER	SPECIES	% C	SPECIES	% C	SPECIES	% C	21. COARSE WOODY DEBRIS (Note type, features, size, etc. found in the plot)
SHRUB							
HERB							
MOSS							

22. COMPETING VEGETATION / NOXIOUS WEEDS

					23. COMMENTS (Expected problem vegetation, potential encroachment from adjacent areas)
SPECIES					
PRESENT HEIGHT (cm)					
EXPECTED HEIGHT (cm)					
PRESENT % COVER					
EXPECTED % COVER					

OVERSTOREY

24. OVERSTOREY

LAYER	SPECIES % (Stems/ha)	AGE	HEIGHT	DBH	STEMS/ha	25. LAYER CONDITION / % ACCEPTABLE / COMMENTS
VETS		+ 40 over Mature				
MATURE (M) 12.5 cm +						
POLES (P) 7.5 -12.5 cm						
SAPLING (S) 1.3 m-7.5 cm						
REGEN. (R) < 1.3 m						

26. SAMPLE TREE DATA (mature layer)

SPECIES					
TOTAL AGE					
HEIGHT					
dbh					
CRN. CLASS					
% LIVE CR.					
10-YR. GR.					

FS 39A-1 HRE 00/11

SOILS

27. FOREST FLOOR DEPTH (cm) ___ + ___ + ___ = ___ (L + F + H = TOTAL) | 28. HUMUS FORM

SOIL HORIZONS (pit depth _____ cm)

29. HORIZON	30. DEPTH (cm)	31. TEXTURE	32. PLASTICITY	33. C. FRAGMTS, %	33. C. FRAGMTS, SIZE	34. COL./ MOIST.

35. ROOTING DEPTH (cm) | 36. DRAINAGE

37. SEASONAL SOIL FACTORS (dates: dry, wet, frozen, snow)

38. UNFAVOURABLE SUBSTRATES

	Y / N	Depth it begins
SEEPAGE (MOTTLES / GLEYING)		____ cm
CARBONATES		____ cm
WATER-RESTRICT LAYER		____ cm
Bt or DENSE PARENT MATERIAL		____ cm
SANDS / GRAVELS		____ cm
FRAGMENTAL (> 70% CF)		____ cm
ROOT-RESTRICT LAYER		____ cm

SPECIFY RESTRICT LAYER TYPE (compact or dense material, bedrock, permanent, seasonal)

OPTIONAL SOILS INFORMATION

39. LANDFORM / PARENT MATERIAL

40. SOIL CLASSIFICATION / ASSOCIATION

41. SURFACE ORGANIC MATTER / SOIL CHARACTERICS

42. C.F. BEDROCK / LITHOLOGY

43. SOIL HAZARD ASSESSMENT *(circle and rate)*

COMP.

13. MOISTURE (27. FOREST FLOOR)	XERIC TO MESIC OR SUBHYGRIC & H HORIZON < 20 cm												SUBHYGRIC & H HOR. ≥20 cm OR HYGRIC TO HYDRIC						
33. COARSE FRAGMENTS	0 - 70%											> 70%	0 - 70%					> 70%	
31. TEXTURE (0 - 30 cm)	Clayey [1]				SI, SiL, Loam				SL, fSL [2]			LS, S	all					all	
RATING	VH				H				M			L	L					VH	M

SOIL DISPLACEMENT

11. SLOPE %	0	5	10	15	20	25	30	35	40	45	52	55	60	65	70	75			
POINTS	0	1	1	2	3	3	4	5	6	8	10	12	16	20	26	32			

PLUS FOR GULLIED TERRAIN ONLY, ADD: (2 or more > 2 m deep / 100 m)	SLOPE GRADIENT			
	N/A	< 30% slope	30 - 45%	> 45%
POINTS	0	2	4	8

18. PLUS, FOR HUMMOCKY TERRAIN, ADD: (broken terrain, small steep knolls)		
	N/A	
POINTS	0	2

38. UNFAVOURABLE SUBSTRATE depth (cm)	< 30	30 - 60	61 - 90	> 90
Hardpan; dense parent material; clean S / gravel; fragmental; carbonates; seepage; bedrock *points*	12	8	4	0

Point Total RATING	*< 7 points* LOW	*7 - 14 points* MODERATE	*15 - 24 points* HIGH	*> 24 points* VERY HIGH

ORGANIC SOIL COMPOSED OF ≥40 cm WET ORGANIC MATERIAL	HIGH
FOREST FLOORS OVER BEDROCK OR SKELETAL MATERIALS (e.g., Folisols)	VERY HIGH

SOIL EROSION

PRECIPITATION FACTOR	*points*	Low	2	Moderate	4	High	8	Very high	8
11. SLOPE %	*points*	0 - 10	1	11 - 20	3	21 - 50	6	> 50	9
17. LENGTH / UNIFORMITY	*points*	short broken	1	short uniform	2	long broken	3	long uniform	4
36. WATER-RESTRICTING LAYER	*points*	> 90 cm	1	61 - 90 cm	2	30 - 60 cm	3	< 30 cm	4
31. TEXTURE (0 - 15 cm)	*points*	SC, C, SiC	1	SiCL, CL, SCL	2	SL, L	4	SiL, SiL, fSL, LS, S	8
33. % COARSE FRAG. (0 - 15 cm)	*points*	> 60	1	31 - 60	2	16 - 30	3	< 16	4
31. SUBSOIL TEXTURE (16-60 cm)	*points*	S, LS, SL, fSL	1	L, SiL, Si	2	CL, SCL, SiCL	3	C, SC, SiC	4
Point Total RATING		*< 16 points* LOW		*16 - 22 points* MODERATE		*23 - 31 points* HIGH		*> 31 points* VERY HIGH	

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1 All textures with Clay in the name (i.e., SC, SiCL, SCL, CL, SiC, C).
2 fSL = fine sandy Loam, like SiL but slightly coarser.

FOR. FLOOR DISPLACEMT[3]

27. LFH excl. rotten wood (cm)			pts.	< 8	— 12	8 - 10	— 8	11 - 20	— 0	> 20	— 4	< 5	— 8	5 - 10	— 6	> 10	— 4	< 10	— 4	< 10	— 2	all	— 0
30. AH DEPTH (cm)				< 1		< 1		< 1		< 1		1 - 2		1 - 2		1 - 2		3 - 5		8 - 10		> 10	
SOIL MATRIX (top 30 cm)[4]		31. TEXTURE		S, LS, SL						f SL, SI				SiL, Loam				all Clayey					
58. COARSE FRAGMENTS	< 30%		points	coarse					4	medium			2	medium			2	fine					8
	30 - 70%		points	very coarse					8	coarse			4	medium			2	medium					2
	> 70%		points	very coarse					8	very coarse			8	coarse			4	medium					2
39. DEPTH TO UNFAVOURABLE SUBSTRATE			points	< 15 cm					12	15 - 30 cm			8	31 - 60 cm			2	> 60 cm					0
11. SLOPE %			points	18. SIDED OR HUMMOCKY TERRAIN						OR > 80%			8	30 - 80%			3	< 30%					0
Point Total **RATING**				*< 9 points* **LOW**						*9 - 14 points* **MODERATE**				*15 - 25 points* **HIGH**				*> 25 points* **VERY HIGH**					

MASS WASTING (INTERIOR ONLY)

DRY RAVELLING OF CONCERN? Non-cohesive soils: S, LS, gravels, volc. pumice or > 70% coarse fragments.																						N/A ☐		
A	Sands or coarse fragments that are rounded, subrounded, flat, platy, or fine gravelly angular			SLOPE %				HAZARD		< 30				LOW	30 - 45			MODERATE	46 - 60			HIGH	> 60	VERY HIGH
	Angular, interlocking coarse fragments, or compacted / cemented / consolidated materials			SLOPE %				HAZARD		< 40				LOW	40 - 58			MODERATE	59 - 70			HIGH	> 70	VERY HIGH
B	OTHERWISE THE RISK OF CUT / FILL SLOPE FAILURE IS: ▼ (Mass wasting hazard is highest of A or B)																							
PRECIPITATION FACTOR			points	Low					0	Moderate			3	High			6	Very high					9
13. MOISTURE REGIME			points	v-xeric-submesic					0	mesic			10	subhygric-hygric			18	subhydric					22
11. SLOPE %			points	< 30		0	30 - 40		3	41 - 50			6	51 - 60			12	61 - 70		24	> 70		36
18. SLOPE GULLYING / CONTINUITY			points	< 30% not gullied					0	Slopes ≥ 30%														
			points	< 30% gullied					4	discontinuous			2	continuous			5	gullied					10
31. MOST LIMITING TEXTURE			points	S, LS					0	SL, f SL			5	Si, SiL, L			10	All Clayey					15
38. WATER-RESTRICTING LAYER				> 90 cm					0	61 - 90 cm			2	30 - 60 cm			3	< 30 cm					4
Point Total **RATING**				*< 22 points* **LOW**						*22 - 38 points* **MODERATE**				*39 - 53 points* **HIGH**				*> 53 points* **VERY HIGH***					

NOTE: Gully systems > 5 m deep require individual assessment. *Consult Slope Stability Specialist if Mass Wasting is very high.

44. SOIL HAZARD SUMMARY

HAZARD	POINTS	RATING
COMPACTION		
SOIL DISPLACEMENT		
SURFACE EROSION		
FOREST FLOOR DISPLACEMENT		
MASS WASTING (Interior)		

45. COMMENTS / SOIL PIT

FOR PHOTOCOPY PURPOSES:	LICENCE NO.	CP	BLOCK	STRATUM	PLOT NO.

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3 Optional hazards, use recommended as per discussion in LMH 47.

4 Use the first mineral soil horizon >15 cm, otherwise use the thickest layer in the top 30 cm of mineral soil.

Plot Card (FS 39A-4)

48. INDICATORS OF POTENTIAL SLOPE INSTABILITY *(check applicable boxes)*

1. LANDSLIDE FEATURES
- ☐ recent landslide scars
- ☐ revegetated landslide scars

2. VEGETATION FEATURES
- ☐ partially revegetated stripe (may also be snow avalanche tracks)
- ☐ jack-strawed trees (trees tilted in various directions), split trees
- ☐ linear strips of even-aged timber
- ☐ pistol butt (recurved) trees (may also indicate snow creep)
- ☐ wet-site vegetation on slopes > 50%

3. SLOPE FEATURES
- ☐ landslide debris piled on lower slope
- ☐ tension fractures
- ☐ numerous springs at toe of slope, sag ponds
- ☐ curved depressions
- ☐ shallow, linear depressions
- ☐ step-like benches or small scarps
- ☐ displaced stream channels
- ☐ ridged marine deposits

4. SOIL FEATURES
- ☐ soil and rocks piled on the upslope side of trees
- ☐ mixed or buried soil profiles
- ☐ poorly developed soils relative to other comparable slopes
- ☐ shallow, wet, organic soils on slopes > 40%
- ☐ poorly drained medium- to fine-textured materials (e.g., till, lacustrine, marine and some glaciofluvial deposits) > 3 m deep

5. BEDROCK /ROCKSLIDE FEATURES
- ☐ talus or scattered boulders at base of slope
- ☐ rock faces with freshly exposed rock
- ☐ steeply dipping, bedrock discontinuities (bedding planes, joints or fracture surfaces, faults) that parallel the slope
- ☐ bedrock joint or fracture surface intersections that dip steeply out of the slope

6. ROAD FEATURES
- ☐ bulges in road

7. GULLY FEATURES
- ☐ poorly drained or gullied*, fine-textured materials < 3 m deep on slopes > 50%
- ☐ poorly drained or gullied*, coarse-textured materials on slopes > 50%
- ☐ recently scoured gullies*
- ☐ vegetation in gully much younger than the adjacent forest
- ☐ exposed soil on gully sides*
- ☐ debris piles at the mouths of gullies*
- ☐ poorly developed soils on gully sides relative to adjacent slopes (repeated shallow failures continually remove the developed soil profile)

*Apply the *Gully Assessment Procedure Guidebook (1995)* to any gullied areas on the Coast.

CONSULT A SLOPE STABILITY SPECIALIST IF ANY INDICATORS ARE FOUND.

IF CONFIRMED, THEN A TERRAIN STABILITY FIELD ASSESSMENT IS REQUIRED.

8. OTHER INDICATORS
- ☐ piping
- ☐ extensive seeps / springs
- ☐ faulted / fractured rock formations
- ☐ extensive outbank failures (interior)
- ☐ tension cracks in middle of road

_____ _____

_____ _____

47. COMMENTS / DIAGRAM

INDICATE SECTION AND ITEM NO. TO WHICH COMMENTS REFER, OR USE FOR SLOPE OR SOIL PROFILE DIAGRAM, ETC.

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BRITISH COLUMBIA

NUMBERS REFER TO LMH 47

SILVICULTURE PRESCRIPTION STRATUM CARD

REF.

1. LICENCE NO.	2. LICENSEE	3. C.P.	4. BLOCK	5. STRATUM AREA (ha)	6. STRATUM

7. SURVEYOR(S) (PRINT)	YYYY - MM - DD	8. PLOT NUMBERS IN STRATUM

SITE

9. BEC ZONE	SUB	VAR	PH	SITE SERIES / %	10. ELEVATION (m) min.	max.	11. SLOPE % min.	max.	avg.

12. CRITERIA DEFINING STRATUM (e.g., BEC site series, forest health factor, soil sensitivity, etc.) DESCRIBE COMPLEX STRATUM IN SUFFICIENT DETAIL TO PERMIT INDIVIDUAL UNITS TO BE IDENTIFIED.

RIPARIAN / WATERSHED VALUES

13. STREAMS (☐ **already assessed,** ☐ N/A) — **an alluvial sediment bed between definable banks**

NAME / IDENTIFICATION	REACH (Average) Length (m)	Width[1] (m)	Gradient %	FISH STREAM Y / N / ?	STREAM CLASS (S?)	RfZ WIDTH (m)	RMZ WIDTH (m)

14. OTHER WATER BODIES (☐ **not applicable**) **NUMBER AND TYPE OF WATER BODY**

___ ☐ LAKE ___ ☐ WETLAND ___ ☐ SPRING / SEEP ___ ☐ OFF-CHANNEL / INTERMITTENT ___ ☐ OTHER

COMMENTS FOR ITEMS 13 AND 14. Describe any water body and determine an appropriate riparian reserve and management zone, if applicable. INCLUDE ANY SPECIAL MANAGEMENT CONSIDERATIONS. For streams, describe bank and streambed materials / characteristics (bank height, shallow, steep, deep, eroding, stable, windthrow, etc.). Describe any distinct riparian vegetation by structure, species, etc.

15. GULLIES[2] (☐ **not applicable** ☐ **already assessed**)

	COAST (gullies > 3 m deep, > 100 m long, > 50% sidewall) CHANNEL					INTERIOR (optional)		
GULLY NO.	% Gradient	Width (m)	Depth (m)	Length (m)	Surficial Materials	ANY RECENT / OLD DEBRIS TORRENT?	GULLY WALL % Slope	Height (m)

16. WATERSHED VALUES (Domestic use? ☐ **Yes** ☐ **No)**

MIGHT HARVESTING / ROAD-BUILDING ACTIVITIES IMPAIR WATER QUALITY OR CAUSE SEDIMENT DELIVERY IN, OR DOWNSTREAM FROM, THE STRATUM?

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1 Horizontal distance between bank tops as determined by the normal high water mark.

2 Gully systems >5 m deep should be typed out and assessed separately for soil disturbance hazard assessment during data collection in the Interior. On the Coast, gullies are subject to a separate gully assessment procedure.

17. RESERVES (☐ not applicable)

DISCUSS ANY PLANNED RESERVES (riparian, lakeshore, wildlife, single tree, patch, etc.) IF WITHIN OR ADJOINING STRATUM

18. SOIL HAZARD / INSTABILITY SUMMARY[3]

	POINTS	RATING
COMPACTION		
SOIL DISPLACEMENT		
SURFACE EROSION		
FOREST FLOOR DISPLACEMENT		
MASS WASTING (Interior)		

ANY SLOPE INSTABILITY INDICATORS PRESENT? ☐ YES ☐ NO
(Refer to FS 39A Plot cards)

Consult Slope Instability Specialist if any slope instability indicators were identified or slope is > 60% and no terrain mapping has been done or in the Interior if Mass Wasting Hazard is VERY HIGH.

19. FIRE HAZARD ABATEMENT

WILL SLASH REDUCTION BE A CONSIDERATION? ☐ YES ☐ NO PREDICT SLASH LOADING AFTER HARVEST.

20. WINDTHROW HAZARD

ANY WINDTHROW EVIDENCE? ☐ YES ☐ NO

NOTE ANY TREE, STAND, SOIL, OR TOPOGRAPHIC FACTORS THAT MAY BE AFFECTED BY STORMS *(refer to FS 39D)*

21. SILVICULTURAL SYSTEMS / MANAGEMENT OBJECTIVES

WITH REFERENCE TO INFORMATION COLLECTED ON-SITE, ESPECIALLY SITE-LIMITING FACTORS AND OPERATIONAL CONSTRAINTS, DISCUSS MANAGEMENT OBJECTIVES FOR THE STRATUM, ALONG WITH DETAILS OF THE CHOSEN SILVICULTURAL SYSTEM, INCLUDING:

- leave trees,
- estimated rotation age
- stand structure and composition
- size of openings for group selection,
- cutting cycle,
- residual BA, etc.

22. HARVESTING

INDICATE MOST APPROPRIATE METHOD SUITED TO THE SELECTED TREE SPECIES AND STAND STRUCTURE GOALS, CONSIDERING ALL THE RESOURCE VALUES IDENTIFIED.

OPERATIONAL CONSTRAINTS (weather, site, seasonal, soil conditions, resource values)

ANY PROPOSED ROUTE(S) LAYOUT CONCERNS (benches,wetlands, etc.)

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3 Where the rating varies (i.e., between plots within the stratum), record the range of ratings obtained.

FOREST HEALTH

23. FOREST HEALTH FACTOR INCIDENCE (for agents present at the time of this survey)

AGENT NAME	TREE SPECIES AFFECTED	% INCIDENCE OF HOST TREES	AND OF TOTAL TREES	OR AREA (ha)	MAGNITUDE OF RISK (L, M, H, VH)

COMMENTS / SPECIAL CONSIDERATIONS (e.g., clarify distribution in or adjacent to stratum, occurrence as continuous or intermittent, tree layer affected, number of dead trees; describe impact to the host, expected future hazard or susceptibility)

SILVICULTURE

24. LIMITING FACTORS

IDENTIFY POSSIBLE FACTORS THAT WILL LIMIT CROP TREE ESTABLISHMENT, SURVIVAL, AND GROWTH

SOILS	HEALTH	CLIMATIC	
☐ cold soils	☐ pests	☐ air temperature extremes	☐ growing season length
☐ shallow soils	☐ root disease	☐ summer frost	☐ moisture deficit / drought
☐ deep organic layer	☐ wildlife damage	☐ frost heaving	OTHER
☐ high % coarse fragments	☐ livestock damage	☐ snow press / damage	☐ vegetation (light)
☐ wet soils	☐ _____	☐ cold-air ponding	☐ vegetation (press)
☐ nutrient-deficient soils	☐ _____	☐ winter desiccation	☐ veg. (moisture / nutrient)
☐ _____	☐ _____	☐ wind	☐ heavy slash
			☐ _____

EXPLAIN AND COMMENT

25. TREE ESTABLISHMENT

☐ NATURAL ☐ PLANT ☐ COMBINATION SAPLINGS COUNTABLE? ☐ YES ☐ NO

ACCEPTABILITY CRITERIA FOR SAPLINGS

IF PLANTING, INDICATE MOST SUITABLE STOCK TYPE(S) AND SPECIES, ALONG WITH ACCEPTABLE MICROSITE CRITERIA AND SEASON.
IF NATURAL, INDICATE FACTORS (e.g., cones, seed trees, saplings, seedbed) THAT MAKE IT A VIABLE METHOD.

26. SITE PREPARATION

IS IT NECESSARY TO AMELIORATE SITE-LIMITING FACTORS THAT CANNOT BE OVERCOME BY STOCKTYPE OR SPECIES CHOICE? ☐ YES ☐ NO
INDICATE LIMITING FACTOR AND METHOD(S) TO AMELIORATE, WITH CONSIDERATION FOR ANY NECESSARY SITE, SOIL, AND SEASONAL CONDITIONS.

FOR PHOTOCOPY PURPOSES:	LICENCE NO.	CP	BLOCK	STRATUM

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STAND TENDING

27. VEGETATION COMPETITION (BRUSHING)

ANTICIPATED? ☐ YES ☐ NO *(Refer to competing vegetation/noxious weeds identified on FS 39A Plot Card)* | TIMING

CONSTRAINTS / METHOD(S)

28. SPACING / PRUNING / FERTILIZATION

SPACING	PRUNING	FERTILIZATION
ANTICIPATED? ☐ YES ☐ NO	ANTICIPATED? ☐ YES ☐ NO	ANTICIPATED? ☐ YES ☐ NO

CONSTRAINTS / METHOD(S)

RESOURCE

RESOURCE VALUES / CONCERNS
For each Section below, consider values in and adjacent to Stratum.

29. PLANT DIVERSITY

EXISTING VALUES (e.g., standing deadwood, large living trees, species diversity, structural diversity, wildlife trees, CWD, surface organic matter)

30. FAUNAL DIVERSITY

EXISTING WILDLIFE AND HABITAT (name(s) of identified species, trails, droppings, tracks, browsing, etc.)

31. FIRST NATIONS / TRADITIONAL USE / CULTURAL HERITAGE

WAS NEW ON-SITE EVIDENCE FOUND? ☐ YES ☐ NO | IF YES, PROVIDE DETAILS

32. LANDSCAPE / RECREATION

ANY FEATURES / CONCERNS NOT PREVIOUSLY IDENTIFIED IN HIGHER-LEVEL PLANS

33. OTHER

EVIDENCE OF WATER IMPROVEMENTS, TRAPPERS, INTEREST GROUPS, GUIDE / OUTFITTERS, NEARBY RESORTS, LANDOWNERS, MINING CLAIM, BOTANICAL FOREST PRODUCTS, HISTORICAL SITES OR TRAILS

34. RANGE (☐ not applicable)

EXISTING RANGE VALUES (barriers, structures, range improvements, noxious weeds, evidence of use by livestock, grazing intensity, etc.)

GRASS SEEDING ACCEPTABLE? ☐ YES ☐ NO | WHERE (landings, whole cutblock)?

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APPENDIX 4 Precipitation factors for biogeoclimatic subzones by forest region

Forest Region	Precipitation Factor			
	Low	Moderate	High	Very high
Cariboo	All BG, PPxh, IDFxm, IDFxw, IDFdk, MSxk, SBSdw, SBSmc*, SBPSxc, SBPSdc, ESSFxv	IDFmw, MSxc, SBSmh, SBSmc*, SBSmw, SBSwk, SBPSmc, SBPSmk, ESSFwk*, ICHdk, ICHmk, ICHwk*	ESSFwc, ESSFwk*, ICHwk*	
Kamloops	All BG, PPxh, IDFxh, IDFxw, IDFdk, IDFdm, MSxk, SBSdh, SBSdw, SBPSmk, ESSFxc	IDFmw, IDFww, MSdc, MSdm, MSmm, SBSmm, ESSFdv, ESSFdc, ICHmk, ICHmw	ESSFwc, ESSFmw, ICHwk, CWHds, CWHms	ESSFvc, ESSFvv, ICHvk
Nelson	PPdh1, PPdh2, IDFm1, IDFdm2, IDFun, IDFxh1	MSdk, MSdm1, ESSFdc1, ESSFdk, ICHdw, ICHmk1, ICHmw1, ICHmw2, ICHmw3, ICHxw	ESSFwc1, ESSFwc2, ESSFwc4, ESSFwm, ICHwk1	ESSFvc, ICHvk1
Prince George	SBSdh, SBSdk, SBSdw, SBSmk1, SBSmc*, BWBSdk, BWBSmw2, BWBSwc3	SBSmh, SBSwk, SBSmw, SBSmk2, SBSmc*, BWBSmw1, BWBSwc1, BWBSwc2, ESSFmm, ESSFmv, ESSFwk* All SWB, ICHmc, ICHmm, ICHwk*	SBSvk, ESSFwc, ESSFwk*, ICHvk, ICHwk*	ESSFvc
Prince Rupert	SBSdk, SBSmc*, SBPSmc, BWBSdk2, BWBSmw2	SBSmc*, ESSFmc, ESSFmk, all SWB, ICHmc	ESSFwv, ICHvc	CWHws1 CWHws2 MHm
Vancouver	All CDF	IDFww	CWHxm, CWHds1, CWHms1, CWHwh1, ESSFmw	CWHdm, CWHds2, MHmm1, CWHvh1, CWHvh2, CWHvm1, CWHvm2, MHmm2

* These subzones/variants encompass two precipitation factor ranges. Use local experience when deciding on the appropriate precipitation factor to apply.

APPENDIX 5 Forest floor displacement hazard key

Forest floor displacement is the mechanical movement of the upper organic materials by equipment and movement of logs. It involves excavation, scalping, mineral soil exposure, and burial of the forest floor.

Effects range from beneficial to detrimental, depending on site factors (e.g., mineral soil characteristics) and degree of forest floor displacement (e.g., how far the displaced forest floor is from the seedlings).

Two aspects of forest floor displacement can produce soil degradation:

- redistribution and loss of nutrients
- exposure of unfavorable rooting medium.

Site factors determining hazards:

- forest floor
  - type
  - depth
- soil texture
- coarse fragment per cent
- slope gradient
- slope complexity
- soil depth to:
  - unfavorable subsoil
  - bedrock
  - seepage
  - carbonates.

Management considerations:

- harvesting system
- silviculture system
- site preparation
  - type
  - pattern
  - prime mover
  - implement
- operating gradient
- depth of scalping
- operator experience, instructions
- seasonal soil moisture content
- ground freezing
- compressibility/depth of snow.

Forest floor displacement hazard key definitions

Close gully spacing – 2 or more >2 m deep, sharp-edged gullies occur per 100 m along the contour. Gentler, rounder gullies are not a concern, since extra excavation would not be involved in crossing such gullies with a bladed structure.

Hummocky terrain – broken terrain with small, but steep-sided knolls or ridges, (e.g., eskers, rocky knobs and drumlins).

Unfavorable subsoils – includes subsoil conditions that produce unfavorable growing conditions when exposed by displacement. Unfavorable subsoils include:

- dense parent materials – compact glacial till, silt, or clay-textured glaciolacustrine, or other soil parent materials that cannot be readily dug into with a shovel (i.e., a pick or pulaski is required to loosen before digging).
- dense, clayey Bt horizons – clay-enriched subsoils of Luvisols >5 cm thick and with clayey textures that cannot be readily dug with a shovel.
- sandy materials with sand or loamy sand texture – granular materials with a low content of silt and clay, and low water-holding and nutrient-storing capacity.
- fragmental materials – subsoils comprised of >70% coarse fragments (i.e., fragments >2 mm diameter).

Carbonate – a soil layer containing appreciable calcium carbonate (lime) in which the soil particles <2 mm in diameter effervesce (fizz) when contacted with 10% HCl (muriatic acid). These calcareous soils may have white coatings on coarse fragments; they may have powdery white deposits in the soil.

Seepage – consider seepage only for subhygric, hygric, and subhydric sites, as indicated by vegetation (site series). For these sites, estimate typical depth of seepage by direct observation of seepage or water table (make allowances for recent weather and spring break-up); or by inference, using soil colors, either mottling or gleying.

Forest floor displacement hazard key[a]

Forest floor										
LFH[b]	<6	6–10	11–20	>20	<5	5–10	>10	<10	<10	all
Ah	<1	<1	<1	<1	1–2	1–2	1–2	3–5	6–10	>10
Points	12	8	6	4	9	6	4	4	2	0

Soil matrix	(top 30 cm)[c]	S, LS, SL	fSL, Si	SiL, Loam	all Clayey
Coarse	<30%	4 (coarse)	2 (med)	2 (med)	8 (fine)
fragments	30–70%	8 (v. coarse)	4 (coarse)	2 (med)	2 (med)
Points	>70%	8 (v. coarse)	8 (v. coarse)	4 (coarse)	2 (med)

Depth to unfavorable subsoil, bedrock, seepage, or carbonates **Points**	<15 cm	15–30 cm	30–60 cm	>60 cm
	12	8	2	0

Slope[d]	>60 %, gullied, or hummocky terrain	30–60%	<30%
Points	6	3	0

Ratings	**Low**	**Moderate**	**High**	**Very high**
Point total	<9	9–14	15–25	>25

a The forest floor displacement hazard rating is determined from the total of points added up for: forest floor LFH depth/Ah depth; soil "matrix" (texture/coarse fragments); depth to unfavorable subsoil, bedrock, seepage, or carbonates; and slope/hummocky terrain.

b Not including rotten wood. The three boxes generally correspond to Mor, Moder, and Mull humus forms, respectively.

c If first or top soil horizon is 15 cm or more thick, use it, otherwise use thickest layer in the top 30 cm of mineral soil.

d Use average slope to determine a rating, but in formulating prescriptions also consider the upper end of the slope range.

Soil texture abbreviations:

S	– sand	LS	– loamy sand
SL	– sandy loam	fSL	– fine sandy loam*
Si	– silt	SiL	– silt loam

All clayey consist of the following textures:

C	– clay	CL	– clay loam
SC	– sandy clay	SiC	– silty clay
SCL	– sandy clay loam	SiCL	– silty clay loam

* For the purposes of this key fSL (fine sandy loam), means the soil contains 30% or more fine or very fine sand, or more than 40% fine and very fine combined. Fine sand is 0.10 – 0.25 mm in diameter, very fine sand is 0.05 – 0.10 mm in diameter.

Mass wasting hazard

Mass wasting hazard assesses susceptibility to small, disturbance-related slope failures—***it is not the same as landslide likelihood*** (landslide likelihood is determined in accordance with the procedures specified in the *Mapping and Assessing Terrain Stability Guidebook*). **Mass wasting hazard** refers primarily to small-scale failures, which mainly cause on-site degradation, while landslide likelihood primarily refers to larger events, which are of concern because of possible off-site impacts. The two hazards are correlated; a very high mass wasting hazard may indicate a potentially unstable slope, and such sites must be checked by a person qualified to assess slope stability. In addition, small, disturbance-related slope failures can lead to larger landslides through drainage diversion or failure of "stacked" excavations up a hillside, such as in switchbacks.

Gully systems >5 m deep should be typed out and assessed separately for soil disturbance hazard assessment during data collection in the Interior. On the Coast, gullies are subject to a separate gully assessment procedure.

The mass wasting hazard key has two parts. The first part has two keys that rate the hazard for dry ravelling in non-cohesive soils and the hazard for cutslope or fill slope failures in more cohesive soils. The second part has a table of field indicators of potential slope instability to help field data collectors identify areas that require a detailed terrain stability site assessment.

Dry ravelling (use on dry Interior sites only) occurs on oversteepened slopes underlain by non-cohesive, granular and fragmental materials.

Cutslope or fill slope failure (use on Interior sites only) These excavation-related slumps may be triggered by removal of supporting slope segments, oversteepening of fill/sidecast slopes, overloading of fill slopes, and/or concentration of drainage waters. **These failures can lead to larger landslides if they cause drainage diversion—this is a common problem in the Interior.** This rating IS NOT used on the Coast.

Site factors determining hazards:

- climate (precipitation factor)
  - rain intensity/duration
  - spring break-up
- topography
  - slope per cent

  - slope length
  - slope continuity
- soil properties
  - texture
  - coarse fragments
  - soil moisture regime
  - restricting layers.

Management considerations:

- logging system
  - ground, cable or helicopter
  - extent of cut and fill
- roads
  - width, cut height, and sidecast
  - drainage structures
  - maintenance
  - deactivation.

Mass wasting hazard key definitions

Precipitation factor – integrates precipitation type, frequency, intensity and duration and the biogeoclimatic subzone/variant. Extract appropriate class from tables in Appendix 4.

Continuous slopes – >150 m slope length between slope segments at least 20 m wide and <30% slope gradient, or between ridge crests and valley bottoms.

Discontinuous slopes – <150 m slope length between slope segments at least 20 m wide and <30% slope gradient (i.e., variable, complex, or benchy slopes), or between ridge crests and valley bottoms.

Gullied – two or more >2 m deep sharp-edged gullies occur per 100 m along the contour.

Water-restricting layer – restricting to downward flow of water, but not necessarily to root growth. Includes impermeable, dense, compact, or cemented layers; bedrock; or permanent water table.

Texture groupings – Use predominant textural group overlying the restricting layer or the most limiting soil texture in the profile.

Clayey = SC, SiC, SCL, SiCL, CL, C.

Mass wasting hazard key

Dry ravelling (use on dry Interior sites only): is a concern if the site is underlain by non-cohesive materials (e.g., sands [S, LS]), gravels, volcanic pumice or fragmental material with >70 % coarse fragment content (e.g., rubbly talus).

Non-cohesive or fragmental materials (sand or >70% coarse fragments)	Slope %			
Sands or coarse fragments that are rounded, subrounded, flat/ platy, or fine gravelly angular	<30	30–45	46–60	>60
Angular, interlocking coarse fragments, or compacted/ cemented/consolidated materials	<40	40–55	56–70	>70
Rating	**Low**	**Moderate**	**High**	**Very high**

Key continued on page 138

Mass wasting hazard key Continued

Cutslope or fill slope failure (use on Interior sites only): add the points for each of the following site factors to determine the hazard for excavation-related cutslope and fill slope failures in more cohesive soil materials.

Precipitation factor	low	moderate	high	very high
Points	**0**	**3**	**6**	**9**

Soil moisture regime[a]	very xeric-submesic	mesic	subhygric-hygric	subhydric
Points	**0**	**10**	**18**	**22**

Slope %	<30	30–40	41–50	51–60	61–70	>70
Points	**0**	**3**	**6**	**12**	**24**	**36**

Slope gullying/	slopes <30%		slopes ≥30 %		
continuity[b]	not gullied	gullied	discontinuous	continuous	gullied
Points	**0**	**4**	**2**	**5**	**10**

Soil texture[c]	S, LS	SL, fSL	Si, SiL, L	clayey
Points	**0**	**5**	**10**	**15**

Depth to water restricting layer[d]	>90	61–90	30–60	<30
Points	**0**	**2**	**3**	**4**

Point total	**<22**	**22–38**	**39–53**	**>53**
Rating	**Low**	**Moderate**	**High**	**Very high**

a It is acceptable to assign moisture regime ratings part way between values, as long as your actions are defendable and the wetter conditions in the standards unit are the ones being rated.

b The continuity of the underlying bedrock is also important on some sites.

c Use the predominant soil texture grouping overlying the restricting layer or the most limiting texture in the profile (which ever is rated highest).

d Deep materials can also pose a hazard, but this is somewhat compensated for by texture (deep deposits that are of concern on slopes are often finer textured).

APPENDIX 7 Further references and information sources

In addition to the main references cited in the text, the following section lists some of the many useful references available to a silviculture prescription surveyor. Any number of topics covered in this handbook can be researched in further detail by consulting this list.

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APPENDIX 8 Forest Practices Code Guidebooks referenced in the text

These guidebooks are integral to the process of conducting silviculture prescription data collection. Readers are advised to reference the most current version of the Forest Practice Code Guidebooks. These may be found at: http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/Guidetoc.htm.

Bark Beetle Management Guidebook

Biodiversity Guidebook

Defoliator Management Guidebook

Dwarf Mistletoe Management Guidebook

Establishment to Free Growing Guidebook(s)

Fertilization Guidebook

Fire Management Guidebook

Fish-stream Identification Guidebook

Forest Health Surveys Guidebook

Gully Assessment Procedure Guidebook

Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes Guidebook

Landscape Unit Planning Guide

Management of Terminal Weevils Guidebook

Mapping and Assessing Terrain Stability Guidebook

Pine Stem Rust Guidebook

Pruning Guidebook

Range Management Guidebook

Riparian Management Area Guidebook

Root Disease Management Guidebook

Silvicultural Systems Guidebook

Silviculture Prescription Guidebook

Site Preparation Guidebook

Soil Conservation Guidebook

Soil Rehabilitation Guidebook

Vegetation Management Guidebook

Visual Identifier Standards Guide

Visual Impact Assessment Guidebook